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44 ENERGY PRODUCTION AND CONVERSION 1497

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION 1498

Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS 1500

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY 1501

Includes weather forecasting and modification.

48 OCEANOGRAPHY 1504

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

51 LIFE SCIENCES (GENERAL) 1506

52 AEROSPACE MEDICINE 1506

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES N.A.

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT 1508

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY N.A.

Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) N.A.

60 COMPUTER OPERATIONS AND HARDWARE 1509

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE 1509

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS 1513

Includes computer networks and special application computer systems.

63 CYBERNETICS 1515

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS 1516

Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY 1517

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS N.A.

Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS 1518

Includes topology and number theory.

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

70 PHYSICS (GENERAL) 1518

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS 1519
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 1520
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 1520
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 1520
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS 1521
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 1527
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 1529
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1530
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 1530
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY N.A.
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1531
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) 1532

89 ASTRONOMY 1555
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 1563
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 1569
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 1570
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 1573
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

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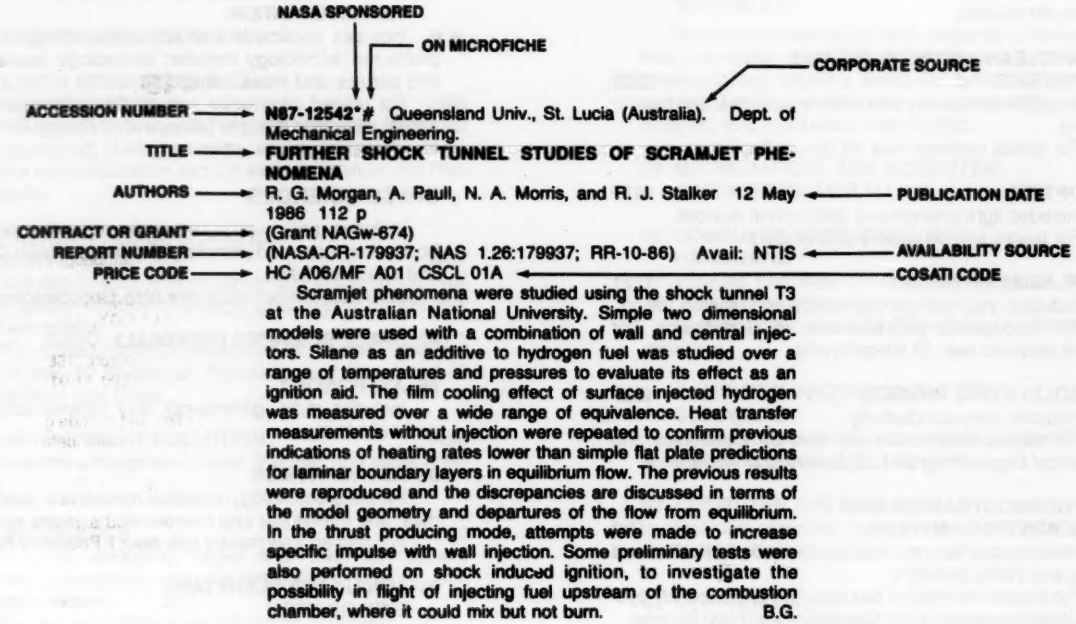
CONTRACT NUMBER INDEX I-63
REPORT/ACCESSION NUMBER INDEX I-65

TYPICAL CITATION AND ABSTRACT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CORPORATE SOURCE
ACCESSION NUMBER
N87-12542*# Queensland Univ., St. Lucia (Australia). Dept. of Mechanical Engineering.
TITLE
FURTHER SHOCK TUNNEL STUDIES OF SCRAMJET PHENOMENA
AUTHORS
R. G. Morgan, A. Paull, N. A. Morris, and R. J. Stalker 12 May 1986 112 p
PUBLICATION DATE
CONTRACT OR GRANT
(Grant NAGw-674)
REPORT NUMBER
(NASA-CR-179937; NAS 1.26:179937; RR-10-86) Avail: NTIS
AVAILABILITY SOURCE
PRICE CODE
HC A06/MF A01 CSCL 01A
COSATI CODE
Scramjet phenomena were studied using the shock tunnel T3 at the Australian National University. Simple two dimensional models were used with a combination of wall and central injectors. Silane as an additive to hydrogen fuel was studied over a range of temperatures and pressures to evaluate its effect as an ignition aid. The film cooling effect of surface injected hydrogen was measured over a wide range of equivalence. Heat transfer measurements without injection were repeated to confirm previous indications of heating rates lower than simple flat plate predictions for laminar boundary layers in equilibrium flow. The previous results were reproduced and the discrepancies are discussed in terms of the model geometry and departures of the flow from equilibrium. In the thrust producing mode, attempts were made to increase specific impulse with wall injection. Some preliminary tests were also performed on shock induced ignition, to investigate the possibility in flight of injecting fuel upstream of the combustion chamber, where it could mix but not burn. B.G.

VOLUME 25 NUMBER 11 / JUNE 8, 1987

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N87-18519* National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 211)
Mar. 1987 142 p
(NASA-SP-7037(211); NAS 1.21:7037(211)) Avail: NTIS HC A07 CSCL 01B

A continuing bibliography (NASA SP-7037) lists 519 reports, journal articles and other documents originally announced in February 1987 in Scientific and Technical Aerospace Reports (STAR) or in the International Aerospace Abstracts (IAA). The coverage includes documents on the engineering and theoretical aspect of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine STAR specific categories and the remaining STAR major categories. The arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals. The IAA items will precede the STAR items within each category. Seven indexes entitled subject, personal author, corporate source, foreign technology, contract number, report number, and accession number are included. Author

N87-18520*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
JOINT UNIVERSITY PROGRAM FOR AIR TRANSPORTATION RESEARCH, 1983
Frederick R. Morrell, comp. Mar. 1987 80 p Conference held in Atlantic City, N.J., 16 Dec. 1983; sponsored by NASA and FAA (NASA-CP-2451; L-16254; NAS 1.55:2451) Avail: NTIS HC A05/MF A01 CSCL 01B

The research conducted during 1983 under the NASA/FAA sponsored Joint University Program for Air Transportation Research is summarized. The material was presented at a conference held at the Federal Aviation Administration Technical Center, Altantic City, New Jersey, December 16, 1983. The Joint University Program is a coordinated set of three grants sponsored by NASA Langley Research Center and the Federal Aviation Administration, one each with the Massachusetts Institute of Technology, Ohio University, and Princeton University. Completed works, status reports, and bibliographies are presented for research topics, which include navigation, guidance, control, and display concepts. An overview of the year's activities for each of the universities is also presented. For individual titles, see N87-18521 through N87-18531.

N87-18521*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
INVESTIGATION OF AIR TRANSPORT TECHNOLOGY AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY, 1983 **c03**
Robert W. Simpson *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 3-9 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

The limitations in providing both centerline and altitude guidance for runways in good Loran-C signal coverage were determined. The high data rate (10/sec) and good repeatable accuracy of Loran-C indicate that it will be possible to provide the pilot with continuous, cross pointer display of guidance information similar to that provided by ILS/MLS, at least when good signal-to-noise ratios and good geometry from Loran-C Lines of Position (LOP) exist at the airport. B.G.

N87-18522*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
DEVELOPMENT OF AN LED DISPLAY SYSTEM FOR CROSS-TRACK DISTANCE AND VELOCITY FOR LORAN-C FLIGHT **c04**
Norry Dogan *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 11-13 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 17G

The methodology for estimating cross-track velocity by combining rate-gyro and Loran-C data is illustrated in block diagrams. At present, preliminary analysis has established values for K sub 1, K sub 2, the parameters of the digital control loops. A computer program was written to implement a digital simulation of the system as illustrated. Given a model for the noise in the rate-gyro and Loran-C receiver, and their dynamic response, the simulation provides a working model to establish good control loop parameters. The layout of the LED display for flight testing of Loran-C approach flying, which was constructed during a visit to Langley Research Center, is shown. Four bar-graph LED displays are paired to provide cross-track distance and velocity from a Loran-C defined runway centerline. Two seven-segment LED displays are used to provide alphanumeric readout of range to touchdown and desired height. A metal case was built, a circuit board designed, and manufactured with the assistance of NASA Langley personnel.
Author

N87-18523*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
LORAN-C APPROACH GUIDANCE PROJECT CURRENT STATUS **c04**
A. L. Elias *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 15-20 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 17G

There are four areas of work in the Loran-C flight test project. Current results provide performance data on the effects of Signal Noise Ratio (SNR) on the dynamic performance of the receiver filters for Loran-C data, and data on Loran-C grid deformation at

a microscale of 100 meters. The Loran-C receiver provides a line of position (LOP) Master and Slave transmitter at an angle 0 to magnetic north. No transformation to latitude-longitude reference frame is required since this is the major source of Loran-C navigation errors. A local coordinate frame is established centered at touchdown point on the runway with directions along and across the runway. A Loran-C data collection system was set up. The Loran-C data are sent directly to an Apple II computer with a 12 inch monitor. The effect of SNR on Loran-C precision is shown for two receiver filters of different frequency response. A set of ground level static readings of touchdown was taken around Hanscom Field and transferred to an accurate detailed layout drawing; this showed local distortions of the average touchdown values. Author

N87-18524*# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
AIR TRANSPORTATION TECHNOLOGY PROGRAM AT OHIO UNIVERSITY, 1983 **c03**
Richard H. McFarland and James D. Nickum *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 23-25 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

The purpose is to provide a research tool, a receiver, such that engineers interested in examining Loran-C performance, usefulness, and other properties will have a flexible, modifiable, and well-known piece of receiving hardware. The significant improvements to the Loran-C receiver are summarized. B.G.

N87-18525*# Ohio Univ., Athens.
SUMMARY OF PAPER: AREA NAVIGATION IMPLEMENTATION FOR A MICROCOMPUTER-BASED LORAN-C RECEIVER **c04**
Fujiko Oguri *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 27-30 (For primary document see N87-18520 11-01)
(TM-88) Avail: NTIS HC A05/MF A01 CSCL 17G

The development of an area navigation program and the implementation of this software on a microcomputer-based Loran-C receiver to provide high-quality, practical area navigation information for general aviation are described. This software provides range and bearing angle to a selected waypoint, cross-track error, course deviation indication (CDI), ground speed, and estimated time of arrival at the waypoint. The range/bearing calculation, using an elliptical Earth model, provides very good accuracy; the error does not exceed more than -.012 nm (range) or 0.09 degree (bearing) for a maximum range to 530 nm. The alpha-beta filtering is applied in order to reduce the random noise on Loran-C raw data and in the ground speed calculation. Due to alpha-beta filtering, the ground speed calculation has good stability for constant or low-accelerative flight. The execution time of this software is approximately 0.2 second. Flight testing was done with a prototype Loran-C front-end receiver, with the Loran-C area navigation software demonstrating the ability to provide navigation for the pilot to any point in the Loran-C coverage area in true area navigation fashion without line-of-sight and range restriction typical of VOR area navigation. Author

N87-18526*# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
MODIFIED TIMING MODULE FOR LORAN-C RECEIVER **c04**
Robert W. Lilley *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 31-38 Previously announced as N83-33866 (For primary document see N87-18520 11-01)
(TM-87) Avail: NTIS HC A05/MF A01 CSCL 17G

Hardware documentation is provided for the modified Loran-C timing module, which used interrupt-driven software control in determing loop sample times. Computer loading is reduced by eliminating polled operation of the timing loop. Author

N87-18527*# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
PATH DISCREPANCIES BETWEEN GREAT CIRCLE AND RHUMB LINE **c04**
Rajan Kaul *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 39-47 Previously announced as N84-17168 (For primary document see N87-18520 11-01)
(TM-98) Avail: NTIS HC A05/MF A01 CSCL 17G

A simulation of a mathematical model to compute path discrepancies between great circle and rhumb line flight paths is presented. The model illustrates that the path errors depend on the latitude, the bearing, and the trip length of the flight. Author

N87-18528*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT PRINCETON UNIVERSITY, 1983 **c03**
Robert F. Stengel *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 51-56 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

Progress is discussed for each of the following areas: voice recognition technology for flight control; guidance and control strategies for penetration of microbursts and wind shear; application of artificial intelligence in flight control systems; and computer-aided aircraft design. B.G.

N87-18529*# Princeton Univ., N. J.
FAILURE DETECTION AND IDENTIFICATION FOR A RECONFIGURABLE FLIGHT CONTROL SYSTEM **c08**
Francois Dallery *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 57-61 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

Failure detection and identification logic for a fault-tolerant longitudinal control system were investigated. Aircraft dynamics were based upon the cruise condition for a hypothetical transonic business jet transport configuration. The fault-tolerant control system consists of conventional control and estimation plus a new outer loop containing failure detection, identification, and reconfiguration (FDIR) logic. It is assumed that the additional logic has access to all measurements, as well as to the outputs of the control and estimation logic. The pilot may also command the FDIR logic to perform special tests. Author

N87-18530*# Princeton Univ., N. J.
AN APPLICATION OF ARTIFICIAL INTELLIGENCE THEORY TO RECONFIGURABLE FLIGHT CONTROL **c08**
David A. Handelman *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 63-72 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

Artificial intelligence techniques were used along with statistical hpyothesis testing and modern control theory, to help the pilot cope with the issues of information, knowledge, and capability in the event of a failure. An intelligent flight control system is being developed which utilizes knowledge of cause and effect relationships between all aircraft components. It will screen the information available to the pilots, supplement his knowledge, and most importantly, utilize the remaining flight capability of the aircraft following a failure. The list of failure types the control system will accomodate includes sensor failures, actuator failures, and structural failures. B.G.

N87-18531*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
DEVELOPMENT OF CONTROL STRATEGIES FOR SAFE MICROBURST PENETRATION: A PROGRESS REPORT **c03**
Mark L. Psiaki *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 73-82 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

A single-engine, propeller-driven, general-aviation model was incorporated into the nonlinear simulation and into the linear

analysis of root loci and frequency response. Full-scale wind tunnel data provided its aerodynamic model, and the thrust model included the airspeed dependent effects of power and propeller efficiency. Also, the parameters of the Jet Transport model were changed to correspond more closely to the Boeing 727. In order to study their effects on steady-state repsonse to vertical wind inputs, altitude and total specific energy (air-relative and inertial) feedback capabilities were added to the nonlinear and linear models. Multiloop system design goals were defined. Attempts were made to develop controllers which achieved these goals. B.G.

N87-18532*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FULL-POTENTIAL MODELING OF BLADE-VORTEX INTERACTIONS
H. E. Jones and F. X. Caradonna (Army Aviation Research and Development Command, Moffett Field, Calif.) Aug. 1986 30 p
(NASA-TM-88355; A-86395; NAS 1.15:88355;
USAAVSCOM-TM-86-A-5) Avail: NTIS HC A03/MF A01 CSCL 01B

A comparison is made of four different models for predicting the unsteady loading induced by a vortex passing close to an airfoil. (1) The first model approximates the vortex effect as a change in the airfoil angle of attack. (2) The second model is related to the first but, instead of imposing only a constant velocity on the airfoil, the distributed effect of the vortex is computed and used. This is analogous to a lifting surface method. (3) The third model is to specify a branch cut discontinuity in the potential field. The vortex is modeled as a jump in potential across the branch cut, the edge of which represents the center of the vortex. (4) The fourth method models the vortex expressing the potential as the sum of a known potential due to the vortex and an unknown perturbation due to the airfoil. The purpose of the current study is to investigate the four vortex models described above and to determine their relative merits and suitability for use in large three-dimensional codes. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N87-18533 Stanford Univ., Calif.
WIND TUNNEL RESONANCE BY THE FINITE ELEMENT METHOD Ph.D. Thesis
In Lee 1986 123 p
Avail: Univ. Microfilms Order No. DA8619776

A finite element approach is developed for predicting the so-called resonant frequencies of subsonic wind tunnels with variously shaped cross sections. It is difficult to predict these frequencies analytically for an arbitrarily shaped cross section, especially in cases with transonic slots and a surrounding plenum chamber. In this case, the finite element method provides a useful numerical alternative. The resulting computer code has been applied to various wind tunnels including the NASA Ames Research Center 6' x 6' wind tunnel (rectangular cross section), and the NASA Langley Research Center 16' x 16' Transonic Dynamics Tunnel (octagonal cross section). The results are believed more accurate than theoretical values used in the past for an equivalent rectangular cross section. The effect of a plenum chamber on the resonance is examined in detail. Application of the finite element approach to the plenum chamber, as it interacts with the test section, gives more accurate results than what would be obtained by assuming an open tunnel. The typical transonic wind tunnel has very narrow slot openings. A method of including the viscosity effect on the resonant frequency is developed for this narrow slot case. Dissert. Abstr.

N87-18534*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ERROR ESTIMATES FOR CELL-VERTEX SOLUTIONS OF THE COMPRESSIBLE EULER EQUATIONS Final Report
P. L. Roe (Cranfield Inst. of Tech., Bedford, England) Jan. 1987 43 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178235; ICASE-87-6; NAS 1.26:178235) Avail: NTIS HC A03/MF A01 CSCL 01A

The cell-vertex schemes due to Ni and Jameson, et al. have been subjected to a theoretical analysis of their truncation error. The analysis confirms the authors' claims for second-order accuracy on smooth grids, but shows that the same accuracy cannot be obtained on arbitrary grids. It is shown that the schemes have a unique generalization to axisymmetric flow that preserves the second-order accuracy. Author

N87-18535*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHOD FOR LAMINAR BOUNDARY LAYER TRANSITION VISUALIZATION IN FLIGHT Patent Application
Bruce J. Holmes, inventor (to NASA) and Peter D. Gall, inventor (to NASA) Filed 13 Nov. 1986 9 p
(NASA-Case-LAR-13554-1; NAS 1.71:LAR-13554-1;
US-Patent-Appl-SN-929862) Avail: NTIS HC A02/MF A01 CSCL 01A

The invention relates to a method of visualizing laminar boundary layer transition in flight and is particularly useful in aerodynamic and hydrodynamic testing. Disclosed is a method of visualizing laminar to turbulent boundary layer transition, shock location, and laminar separation bubbles around a test surface. A liquid crystal coating is formulated using an unencapsulated liquid crystal operable in a temperature bandwidth compatible with the temperature environment around the test surface. The liquid crystal coating is applied to the test surface, which is preferably pretreated by painting with a flat, black paint to achieve a deep matte coating, after which the surface is subjected to a liquid or gas flow. Color change in the liquid crystal coating is produced in response to differences in relative shear stress within the boundary layer around the test surface. The novelty of this invention resides in the use of liquid crystals which are sensitive to shear stress to show aerodynamic phenomena such a boundary layer transition, shock location and laminar separation bubbles around a test surface. Author

N87-18536*# Old Dominion Univ., Norfolk, Va. Dept. of Electrical and Computer Engineering.
THE THERMAL-VORTEX EQUATIONS Final Report
John V. Shebalin Feb. 1987 17 p
(Contract NAS1-17993)
(NASA-CR-178242; NAS 1.26:178242) Avail: NTIS HC A02/MF A01 CSCL 01A

The Boussinesq approximation is extended so as to explicitly account for the transfer of fluid energy through viscous action into thermal energy. Ideal and dissipative integral invariants are discussed, in addition to the general equations for thermal-fluid motion. Author

N87-18537*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HELICOPTER BLADE-VORTEX INTERACTION LOCATIONS: SCALE-MODEL ACOUSTICS AND FREE-WAKE ANALYSIS RESULTS
Danny R. Hoad Apr. 1987 106 p
(Contract DA Proj. 1L1-62209-AH-76-A)
(NASA-TP-2658; L-16214; AVSCOM-TM-87-B-1; NAS 1.60:2658)
Avail: NTIS HC A06/MF A01 CSCL 01A

The results of a model rotor acoustic test in the Langley 4by 7-Meter Tunnel are used to evaluate a free-wake analytical technique. An acoustic triangulation technique is used to locate the position in the rotor disk where the blade-vortex interaction noise originates. These locations, along with results of the rotor free-wake analysis, are used to define the geometry of the

blade-vortex interaction noise phenomena as well as to determine if the free-wake analysis is a capable diagnostic tool. Data from tests of two teetering rotor systems are used in these analyses.
Author

N87-18538*# Grumman Aerospace Corp., Bethpage, N.Y.
AERODYNAMIC ANALYSIS FOR AIRCRAFT WITH NACELLES, PYLONS, AND WINGLETS AT TRANSONIC SPEEDS Final Report
Charles W. Boppe Washington NASA Apr. 1987 148 p
(Contract NAS1-14732)
(NASA-CR-4066; NAS 1.26:4066) Avail: NTIS HC A07/MF A01 CSCL 01A

A computational method has been developed to provide an analysis for complex realistic aircraft configurations at transonic speeds. Wing-fuselage configurations with various combinations of pods, pylons, nacelles, and winglets can be analyzed along with simpler shapes such as airfoils, isolated wings, and isolated bodies. The flexibility required for the treatment of such diverse geometries is obtained by using a multiple nested grid approach in the finite-difference relaxation scheme. Aircraft components (and their grid systems) can be added or removed as required. As a result, the computational method can be used in the same manner as a wind tunnel to study high-speed aerodynamic interference effects. The multiple grid approach also provides high boundary point density/cost ratio. High resolution pressure distributions can be obtained. Computed results are correlated with wind tunnel and flight data using four different transport configurations. Experimental/computational component interference effects are included for cases where data are available. The computer code used for these comparisons is described in the appendices.
Author

N87-18539*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SECONDARY STREAM AND EXCITATION EFFECTS ON TWO-DIMENSIONAL NOIZZLE PLUME CHARACTERISTICS
Uwe H. vonGlahn 1987 23 p Prepared for presentation at the 23rd Joint Propulsion Conference, San Diego, Calif., 29 Jun. - 2 Jul. 1987; sponsored in part by AIAA, SAE, ASME, and ASEE
(NASA-TM-89813; E-3457; NAS 1.15:89813; AIAA-87-2112) Avail: NTIS HC A02/MF A01 CSCL 01A

In order to design two-dimensional nozzle/ejector systems for future high performance aircraft, the basic engine exhaust plume velocity and temperature decay as effected by the secondary stream (ejector) and decay augmentation means must be assessed. Included in the assessment of the plume decay characteristics are the effects of nozzle aspect ratio and nozzle/ejector flow conditions. Nozzle/ejector plume decay can be enhanced by suitable excitation of the plume shear layers. Correlation of these factors are developed in a manner similar to those previously developed for conic and dual-flow nozzle plumes.
Author

N87-18540*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TWO-DIMENSIONAL NOZZLE PLUME CHARACTERISTICS
Uwe H. vonGlahn 1987 23 p Prepared for presentation at the 23rd Joint Propulsion Conference, San Diego, Calif., 29 Jun. - 2 Jul. 1987; sponsored in part by AIAA, SAE, ASME, and ASEE
(NASA-TM-89812; E-3456; NAS 1.15:89812; AIAA-87-2111) Avail: NTIS HC A02/MF A01 CSCL 01A

Future high performance aircraft will likely feature asymmetric or two-dimensional nozzles with or without ejectors. In order to design two-dimensional nozzle/ejector systems of minimum size and weight, the plume decay and spreading characteristics of basic two-dimensional nozzles must first be established. The present work deals with the experimental analyses of these plume characteristics and includes the effects of nozzle aspect ratio and flow conditions (jet Mach number and temperature) on the plume decay and spreading of two-dimensional nozzles. Correlations including these variables are developed in a manner similar to those previously developed successfully for conic and dual-flow plumes.
Author

N87-18541# Sandia National Labs., Albuquerque, N. Mex. Aerodynamics Dept.
INVISCID BOUNDARY LAYER PREDICTION OF AERODYNAMICS FOR A BENT-AXIS BIONIC GEOMETRY
G. F. Polansky and R. W. Noack 1986 11 p
(Contract DE-AC04-76DP-00789)
(DE86-011185; SAND-86-0158C) Avail: NTIS HC A02/MF A01

Newly developed inviscid and boundary layer codes are applied to the prediction of forces and moments for both on-axis and bent-axis bionic orbital transfer vehicle configurations. The inviscid code solves the full three-dimensional form of the nonconservative Euler equations. It features parabolic grid generation and an improved method of characteristic boundary condition. The boundary layer code solves the integral forms of the momentum and energy equation along inviscid streamlines. Generally good agreement is found in comparisons of the inviscid/boundary layer predictions with the experimental data at angles of attack up to 30 deg.
Author

N87-18542# Centre Technique des Industries Mecaniques, Senlis (France).
WIND RESISTANCE OF LARGE DIMENSION BOX STRUCTURES Final Report [RESISTANCE AU VENT DE CAISSONS DE GRANDES DIMENSIONS]
M. Watremetz Oct. 1985 77 p In FRENCH
(CETIM-11M010; ETN-87-99154) Avail: NTIS HC A05/MF A01

Wind tunnel tests on cylindrical and rectangular girders, caissons and plates of various geometries, and on a model of a fork lift truck were carried out to determine the drag coefficients on large dimension structures, which can be exposed to winds of up to 72 km/hr, i.e., in a critical flow regime. Results show the influence of the flow regime and turbulence on object geometry on the drag coefficient.
ESA

N87-18543# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
COMPUTATIONAL DRAG ANALYSIS AND MINIMIZATION. MISSION IMPOSSIBLE?
J. W. Slooff 6 Nov. 1986 28 p Presented at the AGARD Special Course on Aircraft Drag Prediction and Reduction, Rhode-Saint-Genese, Belgium, 20-23 May 1985, and Hampton, Va., 5-6 Aug. 1985
(NLR-MP-85080-U; ETN-87-99295) Avail: NTIS HC A03/MF A01

Drag prediction, analysis, and minimization by computational fluid dynamics (CFD) techniques based on inviscid and viscous inviscid interaction flow models are discussed. Classical and computational means of distinguishing between various drag components; ways to obtain values of drag components from CFD codes and the problem of accuracy; examples of computational drag diagnostics; and computational drag minimization are included. The discussion is limited to sub/transonic transport (wing) aerodynamics, but should be applicable to sub/transonic aerodynamics of fighter aircraft.
ESA

N87-18544# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
MULTICOMPONENT AIRCRAFT TRANSONIC INVISCID COMPUTATION SYSTEM (MATRICS) TRANSONIC POTENTIAL FLOW CALCULATIONS ABOUT TRANSPORT AIRCRAFT
J. vanderVooren, A. J. vanderWees, and J. H. Meelker 14 Mar. 1985 18 p Presented at the AGARD Symposium on Applications of Computational Fluid Dynamics in Aeronautics, Aix-en-Provence, France, 7-10 Apr. 1986
(Contract NIVR-311.1-1076)
(NLR-MP-86019-U; ETN-87-99303) Avail: NTIS HC A02/MF A01

A system under development for the calculation of (potential) flow about transport aircraft is outlined. Details of the full potential flow solver are given. Computer power required and informatics aspects are covered. Results of computations are discussed.
ESA

N87-18545# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
METHODS FOR NUMERICAL SIMULATION OF LEADING-EDGE

VORTEX FLOW
H. W. M. Hoeijmakers 20 Jun. 1984 45 p Presented at a Workshop on Vortex Dominated Flows, Hampton, Va., 9-10 Jul. 1985
(NLR-MP-85052-U; B8673827; ETN-87-99508) Avail: NTIS HC A03/MF A01

Computational methods to simulate the aerodynamics of configurations with leading-edge vortex flow are discussed with a view to three-dimensional steady flow applications. The strengths and weakness of the methods are indicated and results of different methods are compared. ESA

N87-18546# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
REYNOLDS NUMBER EFFECTS AND THE WIND TUNNEL ENVIRONMENT
A. Elsenaar 1 Oct. 1985 16 p Presented at the AGARD Working Group 09 Wind Tunnel Boundary Layer Simulation and Control Submitted for publication
(NLR-MP-86007-U; B8675511; ETN-87-99513) Avail: NTIS HC A02/MF A01

Pseudo Reynolds number effects on wind tunnel test results are discussed. It is shown that many phenomena can be avoided or reduced. However, the natural transition position appears to be critically dependent on a large number of variables: pressure distribution, tunnel noise and turbulence, temperature nonequilibrium, surface roughness, and Reynolds number. For that reason differences in transition location between wind tunnel and flight are likely to occur for other reasons than Reynolds number differences. It remains good practice to either artificially fix the boundary layer or to measure the transition location. ESA

N87-18861*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE CASE FOR AERODYNAMIC SENSITIVITY ANALYSIS
Jaroslaw Sobieszczanski-Sobieski *In its* Sensitivity Analysis in Engineering Feb. 1987 p 77-96 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N87-18547*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OPTIMIZATION OF AIRCRAFT INTERIOR PANELS
Demetrius A. Kourtides and Willard D. Roper (Hercules, Inc., Magna, Utah) Jul. 1986 43 p
(NASA-TM-88340; A-86209; NAS 1.15:88340; DOT/FAA-CT-86) Avail: NTIS HC A03/MF A01 CSCL 01C

Eight different graphite composite panels were fabricated using four different resin matrices. The resin matrices included Hercules 71775, a blend of vinylpolystyrpyridine and bismaleimide, H795, a bismaleimide, Cycom 6162, a phenolic, and PSP 6022M, a polystyrylpyridine. Graphite panels were fabricated using fabric or unidirectional tape. This report describes the processes for preparing these panels and some of their mechanical, thermal and flammability properties. Panel properties are compared with state-of-the-art epoxy fiberglass composite panels. Author

N87-18548# Naval Safety Center, Norfolk, Va.
READINESS AND RETENTION. PILOT FLIGHT EXPERIENCE AND AIRCRAFT MISHAPS Final Report, 1977 - 1985
Michael S. Borowsky 24 Jun. 1986 19 p
(AD-A173911) Avail: NTIS HC A02/MF A01 CSCL 01/2

Budget constraints which yield reductions in flight hours per pilot imply an eventual shifting of the distribution of flight hours. Analyses show that the rate of pilot error mishaps tends to decrease as pilots' flight experience increase. These data suggest, therefore, that as the experience levels of naval aviators decline, the mishap rate will increase. The experience levels of Training Command/ Fleet Readiness Squadron instructor pilots would also tend to decrease, thereby contributing both directly and indirectly to an increased mishap rate. The total effect will, of course, also depend upon aggregate flight hour reductions as well as pilot retention rates. GRA

N87-18549# Simula, Inc., Phoenix, Ariz.
DELETHALIZED CYCLIC CONTROL STICK Final Report, 27 Sep. 1984 - 8 Jul. 1986
C. N. Whitaker and R. E. Zimmerman Jul. 1986 90 p
(Contracts DAAK51-84-C-0022; DA Proj. 1L1-62209-AH-76)
(AD-A173931; TR-86408; USAAVSCOM-TR-86-D-5) Avail: NTIS HC A05/MF A01 CSCL 01/4

In November 1983, the final report for the initial crashworthy cyclic control stick effort was published. The report detailed the development and testing of a purely mechanical self-contained crashworthy cyclic control stick equipped with load-limiting and separating joint. The joint was to limit impact loads transmitted to a crewmember. This report covers the additional development and testing of this concept by Simula Inc. to further delethalize the separating crashworthy cyclic control stick. Using an impact load-limiting grip pad and reduction of the moving mass to reduce the inertial forces, two configurations were subjected to static and dynamic pendululm testings. Additional destructive static testing was performed on both configurations, and one design was selected and tested in a full-scale dynamic test using an anthropomorphic dummy and a vertically stroking UH-60A Black Hawk crewseat. Testing demonstrated that the delethalized stick worked as intended when struck by the dummy. It also showed that the loads transmitted to the dummy were far less than with conventional sticks. GRA

N87-18550# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION, ISSUE NUMBER 13, 1985 ACCIDENTS
25 Aug. 1986 398 p
(PB86-916927; NTSB-AAB-86-27) Avail: NTIS HC A17/MF A01; also available on subscription, North American Continent HC $185.00/year, all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Formal occurring in U.S. civil and foreign aviation operations during Calendar Year 1985. Approximately 200 General Aviation and Air carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. GRA

N87-18551# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION, ISSUE NUMBER 12, 1985 ACCIDENTS
5 Sep. 1986 392 p
(PB86-916926; NTSB-AAB-86-26-Issue-12) Avail: NTIS HC A17/MF A01; also available on subscription, North American Continent HC $185.00/year, all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1985. Approximately 200 General Aviation and Air Carrier accident reports in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. GRA

N87-18552# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.

AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION, ISSUE NUMBER 10, 1985 ACCIDENTS
5 Sep. 1986 408 p
(PB86-916924; NTSB-AAB-86-24) Avail: NTIS HC A18/MF A01; also available on subscription, North American Continent HC $185.00/year, all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1985. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable causes(s) for each accident. GRA

N87-18553# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION, ISSUE NUMBER 9 OF 1985 ACCIDENTS
8 Aug. 1986 405 p
(PB86-916923; NTSB-AAB-86-23) Avail: NTIS HC A18/MF A01; also available on subscription, North American Continent HC $185.00/year, all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Formation occurring in U.S. civil and foreign aviation operations during Calendar Year 1985. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. GRA

N87-18554# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION, ISSUE NUMBER 8, 1985 ACCIDENTS
15 Sep. 1986 396 p
(PB86-916922; NTSB-AAB-86-22) Avail: NTIS HC A17/MF A01; also avaiable on subscription, North American Continent HC $185.00/year, all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1985. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable causes(s) for each accident. GRA

N87-18555# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION, ISSUE NUMBER 17 OF 1984 ACCIDENTS
Jul. 1986 266 p
(PB86-916913; NTSB-AAB-86-13) Avail: NTIS HC A12/MF A01; also available on subscription, North American Continent HC $185.00/year, all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1984. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. GRA

N87-18556# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION ISSUE NUMBER 16 OF 1984 ACCIDENTS
15 Jul. 1986 596 p
(PB86-916912; NTSB-AAB-86-12) Avail: NTIS HC A25/MF A01; also available on subscription, North American Continent HC $185.00/year, all others write for quote CSCL 01B

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1984. Approximately 200 General Aviation and Air Carrier accidents contained in this publication represent a random selection. This publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. GRA

N87-18521*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
INVESTIGATION OF AIR TRANSPORT TECHNOLOGY AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY, 1983
Robert W. Simpson *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 3-9 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

N87-18524*# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
AIR TRANSPORTATION TECHNOLOGY PROGRAM AT OHIO UNIVERSITY, 1983
Richard H. McFarland and James D. Nickum *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 23-25 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

N87-18528*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT PRINCETON UNIVERSITY, 1983
Robert F. Stengel *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 51-56 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

N87-18531*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
DEVELOPMENT OF CONTROL STRATEGIES FOR SAFE MICROBURST PENETRATION: A PROGRESS REPORT
Mark L. Psiaki *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 73-82 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

N87-18557# Royal Signals and Radar Establishment, Malvern (England).
THE USE OF NEW TECHNOLOGY IN THE CONTROL OF CIVIL AIR TRAFFIC AT AIRWAY JUNCTIONS
P. T. Humphrey Jun. 1986 26 p
(AD-A174303; RSRE-86007; DRIC-BR-100657) Avail: NTIS HC A03/MF A01 CSCL 17/7

The methods used to deal with airway junctions at present

are considered, and how new technology could impact on this process in the future is reviewed. GRA

N87-18558# Sandia National Labs., Albuquerque, N. Mex. Exploratory Systems Div. 4.
DATA COMPRESSION TECHNIQUES FOR USE WITH THE SITAN (SANDIA TERRAIN-AIDED NAVIGATION) ALGORITHM
J. R. Fellerhoff and E. E. Creel Jan. 1987 34 p
(Contract DE-AC04-76DP-00789)
(DE87-003782; SAND-86-0827) Avail: NTIS HC A03/MF A01

Data compression algorithms are becoming an important part of systems that use Digital Terrain Elevation Data (DTED) such as moving map display systems, terrain-following and terrain-avoidance systems, and terrain-aided navigation systems. This paper describes and compares two DTED compression techniques for use with the Sandia Terrain-Aided Navigation (SITAN) algorithm designed specifically for operation in a land vehicle. One technique uses the two-dimensional discrete cosine transformation (2-D DCT) combined with linear scaling; the other uses data decimation in the spatial domain, followed by a differential pulse code modulation operation on the decimated spatial data. These techniques are designed to minimize the DTED reconstruction error for a given compression ratio and are targeted for implementation in the Motorola 68000-based Sandia Aerospace Computer. This paper presents a description of the DTED and its use by the SITAN algorithm. Also, background information concerning the 2-D DCT is presented, followed by a description of the two data compression algorithms. Experimental results are presented which show the magnitude of reconstruction errors for various sets of DTED and various compression ratios. Finally, the effect of reconstruction errors on SITAN performance is presented. DOE

N87-18559# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
ASPECTS OF SEA NAVIGATION
G. M. Bosman and C. Wassenaar Feb. 1986 82 p
(ETN-87-99220) Avail: NTIS HC A05/MF A01

Adjustment and testing of offshore navigation data are discussed. The precision of radiopositioning systems is reviewed and ways to derive a covariance matrix for a hyperbolic system are given. Methods to estimate the variance factors are outlined. Lane identification, filtering, conventional least squares adjustment, and the use of a second, independent radiopositioning system are distinguished to detect lane slips. A method to detect lane slips, the Houtenbos filter, is introduced. ESA

N87-18560# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
INVESTIGATION ON MLS APPROACH PATH INTERCEPTION AND TRANSITION TECHNIQUES. PART 2: FLIGHT SIMULATOR INVESTIGATION
L. J. J. Erkelens and P. J. vanderGeest 10 Jan. 1986 148 p
(Contract RLD-523)
(NLR-TR-85097-U-Pt-2; B8678399; ETN-87-99277) Avail: NTIS HC A07/MF A01

The feasibility of the concept of microwave landing system guided interception procedures was assessed. During flight simulations manual (flight director) approaches were executed with a simulated Boeing 747 aircraft. Four interception procedures were studied, and two flight director concepts were examined with respect to their use with these procedures. The flight director systems are based on a closed loop and an open loop concept regarding the turns. Results of the investigation, including the evaluation of the interception procedures, flight director concepts and special avionics, such as an experimental navigation display and a modified horizontal situation indicator are discussed. ESA

N87-18522*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
DEVELOPMENT OF AN LED DISPLAY SYSTEM FOR CROSS-TRACK DISTANCE AND VELOCITY FOR LORAN-C FLIGHT
Norry Dogan *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 11-13
(For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 17G

N87-18523*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
LORAN-C APPROACH GUIDANCE PROJECT CURRENT STATUS
A. L. Elias *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 15-20
(For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 17G

N87-18525*# Ohio Univ., Athens.
SUMMARY OF PAPER: AREA NAVIGATION IMPLEMENTATION FOR A MICROCOMPUTER-BASED LORAN-C RECEIVER
Fujiko Oguri *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 27-30
(For primary document see N87-18520 11-01)
(TM-88) Avail: NTIS HC A05/MF A01 CSCL 17G

N87-18526*# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
MODIFIED TIMING MODULE FOR LORAN-C RECEIVER
Robert W. Lilley *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 31-38 Previously announced as N83-33866 (For primary document see N87-18520 11-01)
(TM-87) Avail: NTIS HC A05/MF A01 CSCL 17G

N87-18527*# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
PATH DISCREPANCIES BETWEEN GREAT CIRCLE AND RHUMB LINE
Rajan Kaul *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 39-47 Previously announced as N84-17168 (For primary document see N87-18520 11-01)
(TM-98) Avail: NTIS HC A05/MF A01 CSCL 17G

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles see *85 Urban Technology and Transportation*.

N87-18561*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HIGH PERFORMANCE FORWARD SWEPT WING AIRCRAFT Patent Application
David G. Koenig, inventor (to NASA), Kiyoshi Aoyagi, inventor (to NASA), Michael E. Dudley, inventor (to NASA), and Susan B. Schmidt, inventor (to NASA) Filed 24 Nov. 1986 27 p
(NASA-Case-ARC-11636-1; US-Patent-Appl-SN-933963; NAS 1.71:ARC-11636-1) Avail: NTIS HC A03/MF A01 CSCL 01C

A high performance aircraft capable of subsonic, transonic and supersonic speeds employs a forward swept wing planform and at least one first-and-second-solution ejector located on the inboard section of the wing. A high degree of flow control on the inboard sections of the wing is achieved along with improved maneuverability and control of pitch, roll and yaw. Lift loss is delayed to higher angles of attack than in conventional aircraft. In one embodiment the ejectors may be advantageously positioned spanwise on the wing while the ductwork is kept to a minimum. NASA

N87-18562# Communications Research Centre, Ottawa (Ontario). Radar and Communications Technology Branch.
SHARP (STATIONARY HIGH ALTITUDE RELAY PLATFORM).

PART A: TECHNICAL FEASIBILITY OF MICROWAVE-POWERED AIRPLANES Summary Report
G. W. Jull Sep. 1986 23 p
(CRC-1393-Pt-A; ISBN-0-662-15215-8) Avail: NTIS HC A02/MF A01

Various types of airplanes and power transmission systems were analyzed. It was found that the cost of a powering system would be considerably reduced if it were to be operated at an ISM frequency of 5.8 GHz rather than at 2.45 GHz. A currently available 2.45 GHz rectenna, capable of power conversion at a power flux density of 500W/square meters was tested to determine microwave to dc conversion efficiency and levels of out-of-band spurious emissions. To gain experience with microwave powering of airplanes, a 1.3m wing span model airplane has been designed and fitted with a novel type of dual polarization rectenna. It is planned to fly this airplane on microwave power. A 6kW transmitter and a 4.5m tracking antenna will be used to provide the power flux density required to fly the airplane to altitudes of up to 70m. It is concluded that there are no insuperable technical problems to achieving feasibility of the airplane and power transmission system. However, an acceptable rectenna has not yet been identified. Further, there are uncertainties in performance of lightweight airplanes in the operational environment. Author

N87-18563*# Lockheed-Georgia Co., Marietta.
APPLICATION OF DECOMPOSITION TECHNIQUES TO THE PRELIMINARY DESIGN OF A TRANSPORT AIRCRAFT Final Report
J. E. Rogan and M. A. Kolb Feb. 1987 300 p
(Contract NAS1-18068)
(NASA-CR-178239; LG86ER0092; NAS 1.26:178239) Avail: NTIS HC A13/MF A01 CSCL 01C

A nonlinear constrained optimization problem describing the preliminary design process for a transport aircraft has been formulated. A multifaceted decomposition of the optimization problem has been made. Flight dynamics, flexible aircraft loads and deformations, and preliminary structural design subproblems appear prominently in the decomposition. The use of design process decomposition for scheduling design projects, a new system integration approach to configuration control, and the application of object-centered programming to a new generation of design tools are discussed. Author

N87-18564# Wisconsin Univ., Madison. Dept. of Mathematics.
OPTIMAL AND INSENSITIVE CONTROL OF HYPERBOLIC DISTRIBUTED PARAMETER SYSTEMS WITH APPLICATIONS TO WING FLUTTER PROBLEMS Final Report, Feb. 1984 - Jan. 1986
David L. Russell Jan. 1986 72 p
(Grant AF-AFOSR-0088-84)
(AD-A174954; AFOSR-86-2187TR) Avail: NTIS HC A04/MF A01 CSCL 20/11

The titles include: On the Dirichlet Neumann Boundary Control Problem Associated with Maxwell's Equations in a Cylindrical Region, A Floquet decomposition for Volterra Equations with Periodic Kernel and a transform Approach to Linear Recursion Equations, and Mathematical Models for the Elastic Beam and their Control Theoretic Implications, and Mathematical Models for the Elastic Beam with Frequency Proportional Damping. GRA

N87-18565# Technische Univ., Brunswick (West Germany). Fakultaet fuer Maschinebau und Elektrotechnik.
INVESTIGATIONS OF FLIGHT PATHS FOR MANEUVERS WITH CONSTANT ENERGY AND CONSTANT CHANGES OF ENERGY INCLUDING DIFFERENT STRATEGIES OF STEERING, CALCULATIONS OF ENERGY REQUIREMENTS FOR GIVEN FLIGHT PATHS, DETERMINATION OF THE CRITERIA FOR SUCCESSFUL COMPLETION OF TURNING MANEUVERS IN THE VERTICAL PLANE Ph.D. Thesis
Michael Soelter 1985 123 p In GERMAN; ENGLISH summary
(ETN-87-99017) Avail: NTIS HC A06/MF A01

Turning maneuvers in the vertical plane for aerobatic and military pilots are studied using mathematical models and system analysis. Starting with the equations for the motion of an airplane in the longitudinal plane for maneuvers with constant energy, it is possible by simple expansion of the formula to include maneuvers with constant changes of energy using the same mathematical model in both cases. By choosing a suitable starting load factor as a parameter for the different steering strategies, a practical variable is defined, which in conjunction with the constant energy change, allows a simple classification of different types of flight paths in the plane of parameters. Simplified formulae facilitate the finding of optimal values and make the conditions obvious for the calculation of boundary areas. By defining simple flight paths, the question for the energy requirements and the feasibility of the maneuver can be determined. ESA

N87-18566# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
TECHNICAL EVALUATION REPORT ON THE AGARD FLUID DYNAMICS PANEL SYMPOSIUM ON IMPROVEMENT OF AERODYNAMIC PERFORMANCE THROUGH BOUNDARY LAYER CONTROL AND HIGH LIFT SYSTEMS
B. Oskam and B. vandenBerg 14 Feb. 1985 11 p Symposium held in Brussels, Belgium, 21-23 May 1984
(NLR-MP-85016-U; B8679800; ETN-87-99506) Avail: NTIS HC A02/MF A01

The importance of research into mechanical high-lift systems for transport aircraft to improve total performance was assessed. Computational techniques are shown to provide new tools for high-lift design. For drag reduction by laminar flow control it is concluded that the information needed to judge whether the laminar flow concept is workable in routine flight operations is becoming available. Research indicates that large benefits of extensive laminar flow on commercial transports may be achievable. Drag reduction by manipulation of turbulence in boundary layers is promising, but research is still in an early stage of development. The control of shock wave boundary layer interactions is also a research area of potential interest. ESA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N87-18567# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Work Group on Ramjet Engines.
THERMODYNAMIC STUDY OF RAMJET ENGINES [ESTUDO TERMODINAMICO DE ESTATO-REATORES]
Carlos Eduardo RolfsenSalles and Walter Gill Dec. 1986 18 p In PORTUGUESE; ENGLISH summary
(INPE-4071-RPE/527) Avail: NTIS HC A02/MF A01

The recent worldwide interest in developing ramjet engines has motivated this preliminary study of the ramjet thermodynamic cycle. Results show that for fixed flight conditions (altitude, flight

Mach number and thrust) there is an optimum combustor temperature which furnishes a minimum fuel consumption. Author

N87-18568# Boeing Aerospace Co., Seattle, Wash. Electrical Power Systems Technology Organization.
CRUISE MISSILE POWER SYSTEM Final Report, Sep. 1981 - Oct. 1984
William G. Dunbar and Sidney W. Silverman Mar. 1986 149 p (Contract F33615-81-C-2057)
(AD-A174324; AFWAL-TR-85-2113) Avail: NTIS HC A07/MF A01 CSCL 10/2

The design and development of an exploratory advanced generator and control unit is described, which would have an improved energy density over present day components. This generator was to be applied to cruise missiles which might be operational with higher power loads in the next 10 to 20 years. Loads were analyzed for future cruise missile missions. The prototype generator and control unit were fabricated and tested to verify the design and the analysis. Concepts reviewed were: mounting the generator and control unit internally on the engine rotor shaft and on the accessory pad, as in the present cruise missile. Because of cooling difficulties, the generator of the size selected could not be integrated in the shaft of any conceived engine size. Thus, the provision is for accessory pad mounting. The weight of the generator and control unit is 27.75 pounds and 227 cubic inches for a 5kW rating. GRA

N87-18569# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
PERFORMANCE OF HIGH TEMPERATURE COATINGS ON F100 TURBINE BLADES UNDER SIMULATED SERVICE CONDITIONS
A. J. A. Mom and H. J. C. Hersbach 20 Mar. 1986 17 p Presented at the International Symposium on High Temperature Corrosion, Marseille, France, 7-12 Jul. 1986
(NLR-MP-86021-U; B8675508; ETN-87-99515) Avail: NTIS HC A02/MF A01

The performance of various pack, gas phase, and noble metal aluminide and overlay coatings, applied on F100 first stage turbine blades, was determined in a 300 hr simulated service tests in a high temperature burner rig using flight-by-flight test conditions. Relative coating life and ranking, based on these particular blade/coating systems, was established. The NiCoCrAlY overlay coating shows superior performance. The coating life of the noble metal aluminides is no better than that of normal aluminides, despite their good oxidation/corrosion behavior. This is due to the brittle nature of the noble metal aluminides, which results in early cracking and spalling. ESA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N87-18570*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT CHARACTERISTICS OF THE AD-1 OBLIQUE-WING RESEARCH AIRCRAFT
Alex G. Sim and Robert E. Curry Mar. 1985 29 p
(NASA-TP-2223; H-1180; NAS 1.60:2223) Avail: NTIS HC A03/MF A01 CSCL 01C

The AD-1 is a low-speed oblique-wing research airplane. This report reviews the vehicle's basic flight characteristics, including many aerodynamic, stability, and control effects that are unique to an oblique-wing configuration. These effects include the change in sideforce with angle of attack, moment changes with angle of attack and load factor, initial stall on the trailing wing, and inertial coupling caused by a roll-pitch cross product of inertia. An assessment of the handling qualities includes pilot ratings and comments. Ratings were generally satisfactory through 30 deg of wing sweep but degraded with increased sweep. A piloted simulation study indicated that a basic rate feedback control system could be used to improve the handling qualities at higher wing sweeps. Author

N87-18571*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INHERENT ROBUSTNESS OF DISCRETE-TIME ADAPTIVE CONTROL SYSTEMS Final Report
C. C. H. Ma Dec. 1986 39 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178224; ICASE-86-79; NAS 1.26:178224) Avail: NTIS HC A03/MF A01 CSCL 01C

Global stability robustness with respect to unmodeled dynamics, arbitrary bounded internal noise, as well as external disturbance is shown to exist for a class of discrete-time adaptive control systems when the regressor vectors of these systems are persistently exciting. Although fast adaptation is definitely undesirable, so far as attaining the greatest amount of global stability robustness is concerned, slow adaptation is shown to be not necessarily beneficial. The entire analysis in this paper holds for systems with slowly varying return difference matrices; the plants in these systems need not be slowly varying. Author

N87-18572*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TILT-ROTOR FLUTTER CONTROL IN CRUISE FLIGHT
Ken-ichi Nasu Dec. 1986 64 p
(NASA-TM-88315; A-86286; NAS 1.15:88315) Avail: NTIS HC A04/MF A01 CSCL 01C

Tilt-rotor flutter control under cruising operation is analyzed. The rotor model consists of a straight fixed wing, a pylon attached to the wingtip, and a three-blade rotor. The wing is cantilevered to the fuselage and is allowed to bend forward and upward. It also has a torsional degree of freedom about the elastic axis. Each rotor blade has two bending degrees of freedom. Feedback of wingtip velocity and acceleration to cyclic pitch is investigated for flutter control, using strip theory and linearized equations of motion. To determine the feedback gain, an eigenvalue analysis is performed. A second, independent, timewise calculation is conducted to evaluate the control law while employing more sophisticated aerodynamics. The effectiveness of flutter control by cyclic pitch change was confirmed. Author

N87-18573# Army Aviation Research and Development Command, Moffett Field, Calif. Aeroflightdynamics Directorate.
INTRODUCTION TO GRASP (GENERAL ROTORCRAFT AEROMECHANICAL STABILITY PROGRAM): A MODERN APPROACH TO ROTORCRAFT MODELING
Dewey H. Hodges, A. S. Hopkins, Donald L. Kunz, and Howard E. Hinnant 1986 18 p Presented at the 42nd Annual Forum of the American Helicopter Society, Washington, D.C., 2-4 Jun. 1986
(AD-A174161) Avail: NTIS HC A02/MF A01 CSCL 01/3

The General Rotorcraft Aeromechanical Stability Program (GRASP) is described in terms of its capabilities and development philosophy. The program is capable of treating the nonlinear static and linearized dynamic behavior of structures represented by arbitrary collections of rigid-body and beam elements that may be connected in an arbitrary fashion and are permitted to have large relative motions. The main limitation is that periodic coefficient effects are not treated, restricting the solutions to rotorcraft in axial flight and ground contact conditions. Rather than following in the footsteps of other rotorcraft programs, GRASP is more of a hybrid between finite element programs and spacecraft-oriented multibody programs. GRASP differs from standard finite-element programs by allowing multiple levels of substructures in which the substructures can move and/or rotate relative to others with no small-angle approximations. This capability facilitates the modeling of rotorcraft structures, including the rotating/nonrotating interface and details of the blade/root kinematics for various rotor types. GRA

N87-18529*# Princeton Univ., N. J.
FAILURE DETECTION AND IDENTIFICATION FOR A RECONFIGURABLE FLIGHT CONTROL SYSTEM
Francois Dallery *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 57-61 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

N87-18530*# Princeton Univ., N. J.
AN APPLICATION OF ARTIFICIAL INTELLIGENCE THEORY TO RECONFIGURABLE FLIGHT CONTROL
David A. Handelman *In* NASA Langley Research Center Joint University Program for Air Transportation Research, 1983 Mar. 1987 p 63-72 (For primary document see N87-18520 11-01)
Avail: NTIS HC A05/MF A01 CSCL 01C

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N87-18574*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
USER GUIDE FOR THE DIGITAL CONTROL SYSTEM OF THE NASA/LANGLEY RESEARCH CENTER'S 13-INCH MAGNETIC SUSPENSION AND BALANCE SYSTEM Final Report, 23 Oct. 1985 - 30 Sep. 1986
Colin P. Britcher Mar. 1987 81 p
(Contract NAS1-17993)
(NASA-CR-178210; NAS 1.26:178210) Avail: NTIS HC A05/MF A01 CSCL 14B

The technical background to the development of the digital control system of the NASA/Langley Research Center's 13 inch Magnetic Suspension and Balance System (MSBS) is reviewed. The implementation of traditional MSBS control algorithms in digital form is examined. Extensive details of the 13-inch MSBS digital controller and related hardware are given, together with the introductory instructions for systems operators. Full listings of software are included in the Appendices. Author

N87-18575*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FULL-SCALE THRUST REVERSER TESTING IN AN ALTITUDE FACILITY
Charles M. Mehalic and Roy A. Lottig 1987 24 p Prepared for presentation at the 23rd Joint Propulsion Conference, San Diego, Calif., 29 Jun. - 2 Jul. 1987; sponsored in part by AIAA, SAE, ASME and ASEE
(NASA-TM-88967; AIAA-87-1788; E-3435; NAS 1.15:88967) Avail: NTIS HC A02/MF A01 CSCL 14B

A two-dimensional convergent-divergent exhaust nozzle designed and fabricated by Pratt and Whitney Aircraft was installed on a PW1128 turbofan engine and tested during thrust reverser operation in an altitude facility at NASA Lewis Research Center. A unique collection system was used to capture the thrust reverser exhaust gas and transport it to the primary exhaust collector. Tests were conducted at three flight conditions with varying amounts of thrust reverse at each condition. Some reverser exhaust gas spillage by the collection system was encountered but engine performance was unaffected at all flight conditions tested. Based on the results of this test program, the feasibility of altitude testing of advanced multi-function exhaust nozzle systems has been demonstrated. Author

N87-18576*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL EVALUATION OF TWO TURNING VANE DESIGNS FOR FAN DRIVE CORNER OF 0.1-SCALE MODEL OF NASA LEWIS RESEARCH CENTER'S PROPOSED ALTITUDE WIND TUNNEL
Donald R. Boldman, Royce D. Moore, and Rickey J. Shyne Mar. 1987 148 p
(NASA-TP-2646; E-3175; NAS 1.60:2646) Avail: NTIS HC A07/MF A01 CSCL 14B

Two turning vane designs were experimentally evaluated for corner 2 of a 0.1 scale model of the NASA Lewis Research Center's proposed Altitude Wind Tunnel (AWT). Corner 2 contained a simulated shaft fairing for a fan drive system to be located downstream of the corner. The corner was tested with a bellmouth inlet followed by a 0.1 scale model of the crossleg diffuser designed to connect corners 1 and 2 of the AWT. Vane A was a controlled-diffusion airfoil shape; vane B was a circular-arc airfoil shape. The A vanes were tested in several arrangements which included the resetting of the vane angle by -5 degrees or the removal of the outer vane. The lowest total pressure loss for vane A configuration was obtained at the negative reset angle. The loss coefficient increased slightly with the Mach number, ranging from 0.165 to 0.175 with a loss coefficient of 0.170 at the inlet design Mach number of 0.24. Removal of the outer vane did not alter the loss. Vane B loss coefficients were essentially the same as those for the reset vane A configurations. The crossleg diffuser loss coefficient was 0.018 at the inlet design Mach number of 0.33. Author

N87-18577# British Aerospace Aircraft Group, Preston (England). Hot Gas Lab.
BAE WHARTON HOT GAS LABORATORY
A. P. Winstanley 1 Oct. 1985 16 p
(ARG-207; ETN-86-96563) Avail: NTIS HC A02/MF A01

A hot gas laboratory was built for experiments requiring large quantities of high pressure air (hot or cold), and was sited to allow test work of a very noisy nature. A ground erosion rig was constructed and commissioned in the laboratory to evaluate the damage caused to ground samples by high pressure and temperature jet efflux. The hot gas is provided by a purpose-built combustion chamber supplied with cold compressed air and aircraft fuel. Testing performed includes erosion of ground surfaces; flow field measurements to assess correlation of hot jet effects with theoretically predicted values of pressure/temperature distributions and heat transfer rates, appraisal for surface coating materials, and study of temperature, velocity, and noise levels near VTOL aircraft.
Author (ESA)

N87-18578# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
FLEXIBLE AND HIGH QUALITY SOFTWARE ON A MULTIPROCESSOR COMPUTER SYSTEM CONTROLLING A RESEARCH FLIGHT SIMULATOR
A. P. L. A. Marsman 30 Sep. 1985 15 p Presented at the AGARD Flight Mechanics Panel, Cambridge, England, 30 Sep. - 3 Oct. 1985
(NLR-MP-85061-U; ETN-87-99291) Avail: NTIS HC A02/MF A01

The research environment and the multiprocessor computer system required for flexible software for flight simulation programs are described. The program incorporates all hardware options with different calibration tables as the most simple solution, since for example the drive laws trimming the primary control systems are different for each system. Modularity of the simulation program allows the usage of subsets of the hardware. Any reasonable combination is possible, with or without motion, visual, flight instruments, etc. Even the primary controls can be replaced by inputs from a file. This enables the flexibility of parallel maintenance of hardware, while testing modified modules in the software. It reduces the costs for projects which do not need all systems.
ESA

N87-18579# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
AERODYNAMIC AND STRUCTURAL ASPECTS OF PROPELLER AND DRIVE FOR A 1/5 SCALE WIND TUNNEL PROGRAM

R. M. Bass, B. Munniksma, and J. vanHengst 19 Sep. 1984 22 p Presented at the AGARD Symposium on Aerodynamics and Acoustics of Propellers, Toronto, Canada, 1-4 Oct. 1984
(Contract NIVR-1985)
(NLR-MP-84091-U; B8677589; ETN-87-99505) Avail: NTIS HC A02/MF A01

The development of a model propeller and its calibration in association with an axisymmetric nacelle in a low speed tunnel before testing on a complete 1/5 scale model are described. The calibration so obtained allowed the required operating propeller conditions to be set up on the complete F50 model. The influence of Reynolds number on propeller performances is discussed and data showing the good agreement obtained, after correction for scale effects, between experimental model results and full scale prediction presented. An unsuspected and unavoidable vibration originating in the reduction gear train of the drive unit gave rise to high propeller blade stresses, ultimately leading to a blade failure. In order to continue running with minimum delay, new propeller blades with high internal damping were manufactured from composite materials, and the program was successfully concluded. ESA

N87-18580# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
REALIZATION OF AN AIRPORT NOISE MONITORING SYSTEM FOR DETERMINING THE TRAFFIC FLOW IN THE SURROUNDINGS OF A MILITARY AIRBASE
G. Bekebrede 7 Feb. 1986 10 p Presented at the International Conference on Noise Control Engineering (INTERNOISE 86), Cambridge, England, 21-23 Jul. 1986
(NLR-MP-86016-U; B8675512; ETN-87-99514) Avail: NTIS HC A02/MF A01

The feasibility study and implementation of a noise measurement system near a military airfield are described. Operating experience shows that the use of a noise monitoring system in the surroundings of a military airbase is restricted, although it functions technically very well and performs its task satisfactorily. ESA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N87-18581*# Science Applications International Corp., Schaumberg, Ill. Advanced Planning and Analysis Div.
SATELLITE SERVICES SYSTEM PROGRAM PLAN
Stephen J. Hoffman Jul. 1985 88 p
(Contract NAS9-17207)
(NASA-CR-171969; NAS 1.26:171969; SAIC-85/1762;
SAIC-1-120-778-S19) Avail: NTIS HC A05/MF A01 CSCL 22A

The purpose is to determine the potential for servicing from the Space Shuttle Orbiter and to assess NASA's role as the catalyst in bringing about routine on-orbit servicing. Specifically this study seeks to determine what requirements, in terms of both funds and time, are needed to make the Shuttle Orbiter not only a transporter of spacecraft but a servicing vehicle for those spacecraft as well. The scope of this effort is to focus on the near term development of a generic servicing capability. To make this capability truly generic and attractive requires that the customer's point of veiw be taken and transformed into a widely usable set of hardware. And to maintain a near term advent of this capability requires that a minimal reliance be made on advanced technology. With this background and scope, this study will proceed through three general phases to arrive at the desired program costs and schedule. The first step will be to determine the servicing requirements of the user community. This will provide the basis for the second phase which is to develop hardware concepts to meet these needs. Finally, a cost estimate will be made for each of the new hardware concepts and a phased hardware development plan will be established for the acquisition of these items based on the inputs obtained from the user community. Author

N87-18582*# Science Applications International Corp., Schaumberg, Ill. Advanced Planning and Analysis Div.
AN INVESTIGATION OF SELECTED ON-ORBIT SATELLITE SERVICING ISSUES
Stephen J. Hoffman Nov. 1986 157 p
(Contract NAS9-17207)
(NASA-CR-171968; NAS 1.26:171968; SAIC-86/1942;
SAIC-1-120-778-S22) Avail: NTIS HC A08/MF A01 CSCL 22A

The results of three separate investigations performed by Science Applications International Corporation (SAIC) between August 1985 and October 1986 as the second phase of the two-phase Satellite Services System Program Plan contract for the Engineering Directorate of the Lyndon B. Johnson Space Center are discussed. The objectives of the first phase of this contract (reported in SAIC-85/1762) were to determine the potential for servicing a diverse range of spacecraft from the Space Shuttle Orbiter and to assess NASA's role as the catalyst in enabling routine on-orbit servicing. The second area of investigation was prompted by the need to understand satellite servicing requirements in the far term (1995 to 2010) and how results from the first phase of this contract could support these requirements. The mission model developed during the first phase was extended using new data and information from studies which address the later time period. The third area of investigation looked at a new servicing mode which had not been studied previously. This mode involves the on-orbit exchange of very large modules with masses greater than approximately 9,000 kilograms and/or lengths greater than approximately nine meters. The viewgraphs used for the final briefing for each of the three investigations, as presented to NASA are given. Author

N87-18583*# Science Applications International Corp., Schaumberg, Ill. Advanced Planning and Analysis Div.
SATELLITE SERVICING PRICE ESTIMATION INSTRUCTION BOOKLET
Jan. 1987 47 p
(Contract NAS9-17207)
(NASA-CR-171967; NAS 1.26:171967; SAIC-87/1515;
SAIC-1-120-778-C15) Avail: NTIS HC A03/MF A01 CSCL 22A

The results of a brief study to develop a possible methodology for estimating the price to non-U.S. Government users for satellite servicing are documented. B.G.

N87-18584*# Martin Marietta Aerospace, Denver, Colo. Fluid Systems Dept.
ORBITAL FLUID SERVICING AND RESUPPLY OPERATIONS
R. N. Eberhardt and W. J. Bailey [1987] 65 p
(Contract NAS9-17585)
(NASA-CR-180238; NAS 1.26:180238) Avail: NTIS HC A04/MF A01 CSCL 22A

The capability to reservice spacecraft and satellites with expendable fluids will provide significant increases in the usability, operational efficiency and cost effectiveness of in-space systems. Initial resupply will be accomplished from the Orbiter cargo bay starting with monopropellant servicing which will eventually be extended to servicing of bipropellants and pressurants. Other fluids, such as freon, ammonia, methanol, superfluid helium, and liquid/gaseous nitrogen may also need to be resupplied once a space station becomes a reality. These fluids/gases are required for subsystem working fluid replacement and payload/experiment fluid replenishment. A logistics module operating on a 90 day schedule is planned for space station servicing. Resupplying hundreds of thousands of pounds of cryogenic propellants and reactants for users such as the Orbital Transfer Vehicle (OTV) also represents future logistics challenges. Implementation of on-orbit fluid transfer requires solving many problems including fluid management in the low-g environment, system docking and interface mating, configuration of user friendly avionics to monitor and control the entire servicing operation, and minimized maintenance and enhanced reliability. Candidate fluid transfer methods and possible gas

transfer methods are discussed, and preliminary storable monopropellant and bipropellant tanker designs are summarized. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N87-18585# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
ASTROMETRIC SATELLITE HIPPARCOS: GRIDSTEP INCONSISTENCY CORRECTION DURING REDUCTION ON CIRCLES Ph.D. Thesis
F. A. vandenHeuvel Apr. 1986 70 p
(ETN-87-99222) Avail: NTIS HC A04/MF A01

Reduction of the HIPPARCOS satellite photon count data on 100,000 stars (100 billion counts) to 2000 so-called reference circle coordinate grids is discussed. Pre and post adjustment procedures were derived and tested. The postadjustment procedure does not need fewer iterations if it is preceded by the preadjustment procedure. It can happen that the iteration does not converge to a consistent solution at all. So a final procedure should not consist of a combination of the pre and postadjustment methods. Most promising is sequential adjustment, because apart from resolving the inconsistencies, it can be used for the improvement of approximate values. If inconsistencies remain after the sequential adjustment the postadjustment method can be used. Not all gridstep errors are detected in the circle reduction. After this step gridstep errors remain in the form of shifts of the adjusted star abscissae over one or more gridsteps. These errors result in inconsistencies, to be resolved in the sphere reconstitution. ESA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N87-18586*# TRW, Inc., Houston, Tex. Systems Engineering and Analysis Dept.
HOST COMPUTER SOFTWARE SPECIFICATIONS FOR A ZERO-g PAYLOAD MANHANDLING SIMULATOR
S. W. Wilson 10 Nov. 1986 239 p
(Contract NAS9-17554)
(NASA-CR-180191; NAS 1.26:180191; TRW-47467-H008-UX-00) Avail: NTIS HC A11/MF A01 CSCL 14B

The HP PASCAL source code was developed for the Mission Planning and Analysis Division (MPAD) of NASA/JSC, and takes the place of detailed flow charts defining the host computer software specifications for MANHANDLE, a digital/graphical simulator that can be used to analyze the dynamics of onorbit (zero-g) payload manhandling operations. Input and output data for representative test cases are contained. Author

N87-18587# Illinois Univ., Urbana. Dept. of Electrical and Computer Engineering.
APPLICATION OF RAILGUN PRINCIPLE TO HIGH-VELOCITY HYDROGEN PELLET INJECTION FOR MAGNETIC FUSION REACTOR REFUELING Technical Progress Report
K. Kim 10 Nov. 1986 138 p
(Contract DE-FG02-84ER-52111)
(DE87-003417; DOE/ER-52111/1-10/86) Avail: NTIS HC A07/MF A01

A detailed experimental study successfully demonstrates the acceleration of frozen hydrogen pellets by means of a fuseless two-stage electromagnetic railgun system. This system consists of a pneumatic hydrogen pellet injector, which freezes and pneumatically pre-accelerates (with high-pressure helium as the propellant gas) cylindrical 1.6-mm-dia by 2.15-mm-long hydrogen pellets, and a 60-cm-long, 1.6-mm-dia circular-bore electromagnetic railgun. The pellet is introduced into the railgun by means of a coupling piece, and a plasma-arc armature is created from the propellant gas by means of a very unique, fuseless, arc-initiation scheme. Railgun-accelerated hydrogen pellet velocities in excess of 1.6 km/s are achieved from pneumatically accelerated injection velocities of 800 m/s. Streak-camera and current-probe data show that the plasma-arc armature moves at a velocity proportional to the railgun current, I. Insight to this I-dependence is gained through the use of streak photography and current probes for varying bore geometries and gas pressures. DOE

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N87-18588*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SYSTEM STUDY OF THE CARBON DIOXIDE OBSERVATIONAL PLATFORM SYSTEM (CO-OPS): PROJECT OVERVIEW
J. Briscoe Stephens and Wilbur E. Thompson Mar. 1987 35 p
(NASA-TP-2696; NAS 1.60:2696) Avail: NTIS HC A03/MF A01 CSCL 22B

The resulting options from a system study for a near-space, geo-stationary, observational monitoring platform system for use in the Department of Energy's (DOE) National Carbon Dioxide Observational Platform System (CO-OPS) on the greenhouse effect are discussed. CO-OPS is being designed to operate continuously for periods of up to 3 months in quasi-fixed position over most global regional targets of interest and could make horizon observations over a land-sea area of circular diameter up to about 600 to 800 statute miles. This affords the scientific and engineering community a low-cost means of operating their payloads for monitoring the regional parameters they deem relevant to their investigations of the carbon dioxide greenhouse effect at one-tenth the cost of most currently utilized comparable remote sensing techniques. Author

N87-18589# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A DESCRIPTION OF THE FAILURE DISTRIBUTIONS OF SELECTED MINUTEMAN 3 GUIDANCE SYSTEM ELECTRONIC CARDS M.S. Thesis
Albert E. Sisk Sep. 1986 90 p
(AD-A174313; AFIT/GLM/LSM/86S-76) Avail: NTIS HC A05/MF A01 CSCL 16/2

This research described the failure distributions of selected Minuteman 3 guidance electronic cards and was the first attempt to use the Total Time on Test graphical technique to detect failure patterns. The data analysis was performed by using a Zenith 100 computer program that performed the Total Time on Test calculations and the Reliability Data Acquisition and Analysis Techniques software package. The objective of the research were to: (1) describe the failure distributions of selected Minuteman 3 electronic cards, (2) determine if the corresponding hazard function demonstrated infant mortality, useful life, or wearout, and (3) suggest management strategies to deal with wearout or infant mortality. Five individual cards were selected and the first three lifetimes of each card were examined. Nine of the fifteen cards indicated an exponential failure distribution, the other six were identified as either a Weibull or a normal failure distribution. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N87-18590*# Martin Marietta Corp., New Orleans, La. Michoud Div.
GPACC PROGRAM COST WORK BREAKDOWN STRUCTURE-DICTIONARY. GENERAL PURPOSE AFT CARGO CARRIER STUDY, VOLUME 3 Final Report
May 1985 82 p
(Contract NAS8-35564)
(NASA-CR-179014-Vol-3; NAS 1.26:179014-Vol-3) Avail: NTIS HC A05/MF A01 CSCL 22B

The results of detailed cost estimates and economic analysis performed on the updated Model 101 configuration of the general purpose Aft Cargo Carrier (ACC) are given. The objective of this economic analysis is to provide the National Aeronautics and Space Administration (NASA) with information on the economics of using the ACC on the Space Transportation System (STS). The detailed cost estimates for the ACC are presented by a work breakdown structure (WBS) to ensure that all elements of cost are considered in the economic analysis and related subsystem trades. Costs reported by WBS provide NASA with a basis for comparing competing designs and provide detailed cost information that can be used to forecast phase C/D planning for new projects or programs derived from preliminary conceptual design studies. The scope covers all STS and STS/ACC launch vehicle cost impacts for delivering payloads to a 160 NM low Earth orbit (LEO). Author

N87-18591*# Martin Marietta Corp., New Orleans, La.
DACC PROGRAM COST AND WORK BREAKDOWN STRUCTURE-DICTIONARY. GENERAL PURPOSE AFT CARGO CARRIER STUDY, VOLUME 2 Final Report
May 1985 62 p
(Contract NAS8-35564)
(NASA-CR-179013-Vol-2; NAS 1.26:179013-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 22B

Results of detailed cost estimates and economic analysis performed on the updated 201 configuration of the dedicated Aft Cargo Carrier (DACC) are given. The objective of this economic analysis is to provide the National Aeronautics and Space Administration (NASA) with information on the economics of using the DACC on the Space Transportation System (STS). The detailed cost estimates for the DACC are presented by a work breakdown structure (WBS) to ensure that all elements of cost are considered in the economic analysis and related subsystem trades. Costs reported by WBS provide NASA with a basis for comparing competing designs and provide detailed cost information that can be used to forecast phase C/D planning for new projects or programs derived from preliminary conceptual design studies. The scope covers all STS and STS/DACC launch vehicle cost impacts for delivering an orbital transfer vehicle to a 120 NM low Earth orbit (LEO). Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N87-18592# Sandia National Labs., Albuquerque, N. Mex. Telemetry Instrumentation Development Div.
TELEMETRY DATA COMPRESSION RESULTING FROM A REAL-TIME DIGITAL SIGNAL PROCESSOR
B. Cloer Aug. 1986 128 p
(Contract DE-AC04-76DP-00789)
(DE86-016059; SAND-85-0814) Avail: NTIS HC A07/MF A01

The task of this telemetry Digital Signal Processor (DSP) is to compress and analyze airborne vehicle vibration in real-time, thus providing significant telemetering bandwidth savings. This compression technique is accomplished by implementing a dedicated hardware design that performs Fourier transformations upon successive stationary time periods of input data channels. An effective bandwidth savings of 54:1 per input channel is afforded by this system when compared to strictly analog transmission. The input data sample rate is set at 8192 samples per second. An eighth-order low-pass Butterworth filter with a cutoff frequency of 2040 Hz attenuates input analog data. Contiguous blocks of 1024 points are Fourier transformed, converted to power spectral densities (PSD) and subsequently logarithmically averaged to produce the compressed results. The DSP system is developed around a dual array chip set from Honeywell that performs the Fourier transform algorithmic intensive calculations. In addition, an Intel 80196 processor is responsible for concurrent real-time acquisition from three channels as well as PSD and logarithmic data averaging. The system requires 14 watts from +5V, +/-12V, +3.3V power inputs. DOE

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N87-18593*# Martin Marietta Corp., Denver, Colo.
STUDY OF SELECTED TETHER APPLICATIONS IN SPACE, PHASE 3, VOLUME 2 Final Report
Sep. 1986 112 p
(Contract NAS8-36616)
(NASA-CR-178936-Vol-2; NAS 1.26:178936-Vol-2; MCR-86-1346-Vol-2; DPD-665-Vol-2; DR-04-Vol-2) Avail: NTIS HC A06/MF A01 CSCL 22B

The results of a Phase 3 study of two Selected Tether Applications in Space (STAIS); deorbit of a Shuttle and launch of an Orbital Transfer Vehicle (OTV), both from the space station using a tether were examined. The study objectives were to: perform a preliminary engineering design, define operational scenarios, develop a common cost model, perform cost benefits analyses, and develop a Work Breakdown Structure (WBS). Key features of the performance analysis were to identify the net increases in effective Shuttle cargo capability if tethers are used to assist in the deorbit of Shuttles and the launching of the OTVs from the space station and to define deployer system designs required to accomplish these tasks. Deployer concepts were designed and discussed. Operational scenarios, including timelines, for both tethered and nontethered Shuttle and OTV operations at the space station were evaluated. A summary discussion of the Selected Tether Applications Cost Model (STACOM) and the results of the cost benefits analysis are presented. Several critical technologies needed to implement tether assisted deployment of payloads are also discussed. Conclusions and recommendations are presented. B.G.

N87-18594*# Martin Marietta Corp., Denver, Colo.
STUDY OF SELECTED TETHER APPLICATIONS IN SPACE, PHASE 3, VOLUME 1 Executive summary
Sep. 1986 26 p
(Contract NAS8-36616)
(NASA-CR-178935-Vol-1; NAS 1.26:178935-Vol-1;

MCR-86-1346-Vol-1; DPD-665-Vol-1; DR-04-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 22B

A dual keel space station configuration was used. The Mobility System, created for moving components over one face of the Space Station, makes it possible to use a single tether deployer system for both Orbit Transfer Vehicles (OTV) and Shuttle launches. Deployer concepts ranging from a minimum capability system that can deorbit the Shuttle from a maximum altitude of 370 km to a full capability system that can deploy the OTN with 9,072 kg of payload and using 150 km of tether were designed and discussed. Results of the cost benefits analyses are discussed. Conclusions and recommendations for implementing a specific design configuration and for future development and study activities are presented. B.G.

N87-18595*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

LOCKING HINGE Patent Application

Clarence J. Wesselski, inventor (to NASA) Filed 29 Oct. 1986 16 p

(NASA-Case-MSC-21056-1; NAS 1.71:MSC-21056-1; US-Patent-Appl-SN-924397) Avail: NTIS HC A02/MF A01 CSCL 22B

The space station configuration currently being studied utilizes structures which require struts to be hinged in the middle in stowed configuration and locked into place in the deployed configuration. Since there are hundreds of hinges involved, it is necessary that they have simple, positive locking features with a minimum of joint looseness or slack. The instant invention comprises two similar housings hinged together with a spring loaded locking member which assists in making the lock as well as breaking it. The instant invention comprises a bracket hinge and bracket members with a spring biased and movable locking member. The locking or latch member has ear parts received in locking openings where wedging surfaces on the ear parts cooperate with complimentary surfaces on the bracket members for bringing the bracket members into a tight end-to-end alignment when the bracket members are in an extended position. When the locking member is moved to an unlocking position, pivoting of the hinge about a pivot pin automatically places the locking member to retain the locking member in an unlocked position. In pivoting the hinge from an extended position to a folded position, longitudinal spring members are placed under tension over annular rollers so that the spring tension in a folded position assists in return of the hinge from a folded position to an extended position. Novelty lies in the creation of a locking hinge which allows compact storage and easy assembly of structural members having a minimal number of parts. Author

N87-18596*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SPACE STATION ERECTABLE MANIPULATOR PLACEMENT SYSTEM Patent Application

Margaret E. Grimaldi, inventor (to NASA) Filed 13 Nov. 1986 13 p

(NASA-Case-MSC-21096-1; NAS 1.71:MSC-21096-1; US-Patent-Appl-SN-929865) Avail: NTIS HC A02/MF A01 CSCL 22B

A habitable space station has been proposed for low Earth orbit, to be constructed from components which will be separately carried up from the Earth and thereafter assembled. A suitable manipulating system having extraordinary manipulative capability is required. The invention is an erectable manipulator placement system for use on a space station and comprising an elongate, lattice-like boom having guide tracks attached thereto, a carriage-like assembly pivotally mounted on and extending from said dolly. The system further includes a turntable base pivotally interconnected with the proximal end of the boom and positioned either on a part of a transferring vehicle, or on another payload component being carried by said transferring vehicle, or on the space station. Novelty resides in the use of a turntable base having a hinged boom with a dolly translatable therealong to carry the arm-like assembly, thus providing an additional 3 degrees of freedom to the arm. Author

N87-18597*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

EXPANDABLE PALLET FOR SPACE STATION INTERFACE ATTACHMENTS Patent Application

Clarence J. Wesselski, inventor (to NASA) Filed 13 Nov. 1986 18 p

(NASA-Case-MSC-21117-1; NAS 1.71:MSC-21117-1; US-Patent-Appl-SN-929875) Avail: NTIS HC A02/MF A01 CSCL 22B

The present invention is directed to a foldable expandable pallet having a basic square configuration. Each pallet is comprised of a plurality of struts joined together by node point fittings to make a rigid structure. The struts have hinge fittings which are spring loaded to permit collapse of the module for stowage transport to a space station in the payload bay of the space shuttle, and deployment on orbit. Dimensions of the pallet are selected to provide convenient, closely spaced attachment points between the node points of the relatively widely spaced trusses of a space station platform. A pallet is attached to a truss at four points: one close fitting hole; two oversize holes, and a slot which allows for thermal expansion/contraction and for manufacturing tolerances. Applications of the pallet include its use to attach rotary joints. Also, the pallet can serve as a splint with gridded plates; as instrument mounting bases; and as a roadbed for a Mobile Service Center (MSC). The novelty resides in providing closely spaced attachment points for mounting small components to the space station beams with widely spaced attachment points. The foldable expandable pallet removes the constraint that the main structure must have closely spaced node points for attachment purposes. Author

N87-18598*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

INTEGRATED STRUCTURE ELECTROMAGNETIC OPTIMIZATION OF LARGE SPACE ANTENNA REFLECTORS

Sharon L. Padula, Howard M. Adelman, and M. C. Bailey Feb. 1987 12 p Proposed for presentation at the AIAA/ASME/ASCE/AHS 28th Structures, Structural Dynamics and Materials Conference, Monterey, Calif., 6-8 Apr. 1987

(NASA-TM-89110; NAS 1.15:89110; AIAA-87-0824-CP) Avail: NTIS HC A02/MF A01 CSCL 22B

The requirements for extremely precise and powerful large space antenna reflectors have motivated the development of a procedure for shape control of the reflector surface. A mathematical optimization procedure has been developed which improves antenna performance while minimizing necessary shape correction effort. In contrast to previous work which proposed controlling the rms distortion error of the surface thereby indirectly improving antenna performance, the current work includes electromagnetic (EM) performance calculations as an integral of the control procedure. The application of the procedure to a radiometer design with a tetrahedral truss backup structure demonstrates the potential for significant improvement. The results indicate the benefit of including EM performance calculations in procedures for shape control of large space antenna reflectors. Author

N87-18599*# Auburn Univ., Ala. Dept. of Aerospace Engineering.

SATELLITE ATTITUDE MOTION MODELS FOR CAPTURE AND RETRIEVAL INVESTIGATIONS

John E. Cochran, Jr. and Brian S. Lahr Oct. 1986 87 p

(Contract NAS8-36470)

(NASA-CR-179016; NAS 1.26:179016) Avail: NTIS HC A05/MF A01 CSCL 22B

The primary purpose of this research is to provide mathematical models which may be used in the investigation of various aspects of the remote capture and retrieval of uncontrolled satellites. Emphasis has been placed on analytical models; however, to verify analytical solutions, numerical integration must be used. Also, for satellites of certain types, numerical integration may be the only practical or perhaps the only possible method of solution. First, to provide a basis for analytical and numerical work, uncontrolled satellites were categorized using criteria based on: (1) orbital

motions, (2) external angular momenta, (3) internal angular momenta, (4) physical characteristics, and (5) the stability of their equilibrium states. Several analytical solutions for the attitude motions of satellite models were compiled, checked, corrected in some minor respects and their short-term prediction capabilities were investigated. Single-rigid-body, dual-spin and multi-rotor configurations are treated. To verify the analytical models and to see how the true motion of a satellite which is acted upon by environmental torques differs from its corresponding torque-free motion, a numerical simulation code was developed. This code contains a relatively general satellite model and models for gravity-gradient and aerodynamic torques. The spacecraft physical model for the code and the equations of motion are given. The two environmental torque models are described. Author

N87-18600*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
GROUND FACILITY FOR LARGE SPACE STRUCTURES DYNAMICS AND CONTROL VERIFICATION
Henry Waites Nov. 1986 15 p
(NASA-TM-86558; NAS 1.15:86558) Avail: NTIS HC A02/MF A01 CSCL 22B

NASA Marshall Space Flight Center has developed a facility in which closed loop control of Large Space Structures (LSS) can be demonstrated and verified. The main objective of the facility is to verify LSS control system techniques so that on-orbit performance can be unsured. The facility consists of an LSS test article or payload which is connected to a 3-axis angular pointing mount assembly that provides control torque commands. The angular pointing mount assembly is attached to a base excitation system which will simulate disturbances most likely to occur for Orbiter and DOD payloads. The control computer contains the calibration software, the reference systems, the alignment procedures, the telemetry software, and the control algorithms. The total system is suspended in such a fashion that the LSS test article has the characteristics common to all LSS. Author

N87-18601*# Martin Marietta Aerospace, Denver, Colo.
SHUTTLE/SPACELAB CONTAMINATION ENVIRONMENT AND EFFECTS HANDBOOK
L. E. Bareiss, R. M. Payton, and H. A. Papazian Washington NASA Sep. 1986 243 p
(Contract NAS8-35770)
(NASA-CR-3993; NAS 1.26:3993; MCR-85-583) Avail: NTIS HC A11/MF A01 CSCL 22B

This handbook is intended to assist users of the Spacelab/Space Transportation System by providing contamination environments and effects information that may be of value in planning, designing, manufacturing, and operating a space flight experiment. A summary of available molecular and particulate contamination data on the Space Transportation System and its facilities is presented. Contamination models, contamination effects, and protection methods information are also presented. In addition to contamination, the effects of the space environments at STS altitudes on spacecraft materials are included. Extensive references, bibliographies, and contacts are provided. Author

N87-18602# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
DYNAMICS OF FLEXIBLE SPACECRAFT: THE INTERNAL BALANCING APPROACH TOWARDS MATHEMATICAL MODEL ORDER REDUCTION
P. Th. L. M. vanWoerkom 31 Oct. 1985 160 p
(Contract NIVR-1910)
(NLR-TR-85127-U; B8680487; ETN-87-99280) Avail: NTIS HC A08/MF A01

The use of the internal balancing approach for spacecraft mathematical model order reduction and dynamic systems analysis is reviewed. It can be used to obtain a Kalman canonical decomposition, in terms of subsystem controllability and observability properties. The subsystems thus identified display a certain ranking: the controllable and observable subsystem is in internally balanced form, the controllable but not observable subsystem displays controllability ranking, and the not controllable but observable subsystem displays observability ranking. The approach is straightforward as to numerical evaluation. In its application to reduction of the model order of flexible spacecraft dynamics, the approach ranks the flexible modes. The ranking parameter is a function of modal controllability, modal observability, modal frequency, and modal damping ratio. ESA

N87-19269# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE PROPOSED LYMAN FAR ULTRAVIOLET SPECTROSCOPIC EXPLORER
Jeffrey L. Linsky *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 537-549 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N87-18603*# Aerojet Technical Systems Co., Sacramento, Calif.
CONFIGURATION EVALUATION AND CRITERIA PLAN. VOLUME 2: EVALUATION CRITERA PLAN (PRELIMINARY). SPACE TRANSPORTATION MAIN ENGINE (STME) CONFIGURATION STUDY
E. K. Bair Aug. 1986 32 p
(Contract NAS8-36867)
(NASA-CR-178940-Vol-2; NAS 1.26:178940-Vol-2; RPT/BB0323-Vol-2; DR-9-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 21H

The unbiased selection of the Space Transportation Main Engine (STME) configuration requires that the candidate engines be evaluated against a predetermined set of criteria which must be properly weighted to emphasize critical requirements defined prior to the actual evaluation. The evaluation and selection process involves the following functions: (1) determining if a configuration can satisfy basic STME requirements (yes/no); (2) defining the evaluation criteria; (3) selecting the criteria relative importance or weighting; (4) determining the weighting sensitivities; and (5) establishing a baseline for engine evaluation. The criteria weighting and sensitivities are cost related and are based on mission models and vehicle requirements. The evaluation process is used as a coarse screen to determine the candidate engines for the parametric studies and as a fine screen to determine concept(s) for conceptual design. The criteria used for the coarse and fine screen evaluation process is shown. The coarse screen process involves verifying that the candidate engines can meet the yes/no screening requirements and a semi-subjective quantitative evaluation. The fine screen engines have to meet all of the yes/no screening gates and are then subjected to a detailed evaluation or assessment using the quantitative cost evaluation processes. The option exists for re-cycling a concept through the quantitative portion of the screening and allows for some degree

of optimization. The basic vehicle is a two stage LOX/HC, LOX/LH2 parallel burn vehicle capable of placing 150,000 lbs in low Earth orbit (LEO). Author

N87-18604*# Aerojet Technical Systems Co., Sacramento, Calif.
CONFIGURATION EVALUATION AND CRITERIA PLAN. VOLUME 1: SYSTEM TRADES STUDY AND DESIGN METHODOLOGY PLAN (PRELIMINARY). SPACE TRANSPORTATION MAIN ENGINE (STME) CONFIGURATION STUDY
E. K. Bair Aug. 1986 24 p
(Contract NAS8-36867)
(NASA-CR-178939-Vol-1; NAS 1.26:178939-Vol-1; RPT/BB0324-Vol-1; DR-9-Vol-1) Avail: NTIS HC A02/MF A01 CSCL 21H

The System Trades Study and Design Methodology Plan is used to conduct trade studies to define the combination of Space Shuttle Main Engine features that will optimize candidate engine configurations. This is accomplished by using vehicle sensitivities and engine parametric data to establish engine chamber pressure and area ratio design points for candidate engine configurations. Engineering analyses are to be conducted to refine and optimize the candidate configurations at their design points. The optimized engine data and characteristics are then evaluated and compared against other candidates being considered. The Evaluation Criteria Plan is then used to compare and rank the optimized engine configurations on the basis of cost. Author

N87-18605*# Remtech, Inc., Huntsville, Ala.
MEASUREMENTS FOR LIQUID ROCKET ENGINE PERFORMANCE CODE VERIFICATION
Sarat C. Praharaj and Richard L. Palko Oct. 1986 110 p
(Contract NAS8-36548)
(NASA-CR-179025; NAS 1.26:179025; RTR-157-01) Avail: NTIS HC A06/MF A01 CSCL 21H

The goal of the rocket engine performance code verification tests is to obtain the I sub sp with an accuracy of 0.25% or less. This needs to be done during the sequence of four related tests (two reactive and two hot gas simulation) to best utilize the loss separation technique recommended in this study. In addition to I sub sp, the measurements of the input and output parameters for the codes are needed. This study has shown two things in regard to obtaining the I sub sp uncertainty within the 0.25% target. First, this target is generally not being realized at the present time, and second, the instrumentation and testing technology does exist to obtain this 0.25% uncertainty goal. However, to achieve this goal will require carefully planned, designed, and conducted testing. In addition, the test-stand (or system) dynamics must be evaluated in the pre-test and post-test phases of the design of the experiment and data analysis, respectively always keeping in mind that a .25% overall uncertainty in I sub sp is targeted. A table gives the maximum allowable uncertainty required for obtaining I sub sp with 0.25% uncertainty, the currently-quoted instrument specification, and present test uncertainty for the parameters. In general, it appears that measurement of the mass flow parameter within the required uncertainty may be the most difficult. Author

N87-18606# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
VEHICLE GLOW OBSERVED DURING A ROCKET SOUNDING EXPERIMENT
B. R. Clemesha, H. Takahashi, and Y. Sahai Nov. 1986 19 p Submitted for publication
(Contract FINEP-537/CT)
(INPE-4057-PRE/1016) Avail: NTIS HC A02/MF A01

In a recent rocket-borne photometer experiment strong contaminating signals were observed at 5577A and 7619A. The contamination was observed in the ram direction on both upleg and downleg trajectories and no contamination was observed in the wake direction. A strongly spin-modulated signal was observed at heights up to 88 km on the upleg and at heights below 78 km, where the rocket inverted, on the downleg. The signals at both wavelengths were observed to decrease exponentially with increasing height, but with different e-folding intervals, the latter being 1.23 km for the OI 5577A emission and 2.65 km for the O2 7619A. At a height of 81.5 km the intensities were the same and were equal to 220 Rayleighs per Angstrom. It is suggested that the contamination glow most probably has its origin in reactions involving atomic species produced by thermal dissociation in the shock wave in front of the photometers. Author

N87-18607*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
IGNITION OVERPRESSURE STUDY FROM SOLID ROCKET MOTOR FIRINGS
Douglas D. Counter Mar. 1987 31 p
(NASA-TM-86587; NAS 1.15:86587) Avail: NTIS HC A03/MF A01 CSCL 21H

The objective was to investigate, through experimental means, the basic mechanisms influencing ignition overpressure and to determine ways to suppress ignition overpressure. Ignition overpressure was studied using solid rocket motors with geometry scaled at 1 percent of the Shuttle's Solid Rocket Boosters. Both water injection and aerosol foam were examined as a mean of reducing ignition overpressure. The results of the water injection tests indicate that a relatively small amount of water is sufficient to provide significant suppression. Of the flow rates tested, the lower water injection flow rates provided the best reduction of the ignition overpressure wave. Also, the test results show there is an optimum water flow rate range that provides the best suppression, and as this range is exceeded the effectiveness of water to reduce ignition overpressure is decreased. Aerosol foam provided very little reduction of ignition overpressure, but only small volumes of foam were used and further testing is necessary to determine its total effectiveness as a means of suppression. Author

N87-18608# Army Armament Research and Development Command, Dover, N. J. Armament Engineering Directorate.
AN ANALYTICAL MODEL OF AN IMPULSIVE THRUSTER Final Report
Eugene M. Friedman, Michael J. Amoruso, and Romel Campbell Nov. 1986 25 p
(AD-A174397; ARAED-TR-86034) Avail: NTIS HC A02/MF A01 CSCL 19/1

The use of impulsive or nearly impulsive thrusters for the maneuvering force on artillery projectiles has recently been of great interest. The computational cost of numerically integrating the force and torque of distributed thrusters has been high. A method is developed for the one-step application of an exact solution of the flight mechanics for a helical thruster distribution on an axisymmetric body. GRA

N87-18609# Sandia National Labs., Albuquerque, N. Mex.
DEVELOPMENT OF A SMALL HIGH-THRUST TRACTOR ROCKET MOTOR
C. E. Carr and W. F. Oberlander 1986 43 p Presented at the JANNAF Propulsion Meeting, New Orleans, La., 26 Aug. 1986
(Contract DE-AC04-76DP-00789)
(DE86-015831; SAND-86-7127C; CONF-8608100-2) Avail: NTIS HC A03/MF A01

This paper summarizes the parachute extraction tractor rocket motor design and test efforts conducted during the Sandia ASW/SOW development program. The prime contractor was Sandia National Laboratories, Albuquerque, New Mexico; the tractor rocket motor subcontractor was Morton Thiokol, Inc., Elkton, Maryland. DOE

N87-18610# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
PERFORMANCE OF ROCKET MOTORS WITH METALLIZED PROPELLANTS
D. Reydellet, ed. Sep. 1986 84 p
(AGARD-AR-230; ISBN-92-835-1534-X; AD-A175565) Avail: NTIS HC A05/MF A01

Different methods were used to calculate and predict the performance of solid rocket motors with metallized propellants.

An AGARD Working Group was formed in order to compare the different prediction methods, to investigate the sources of inaccuracy and to make recommendations for future applications. The Working Group performed calculations and predictions with different methods for two test cases and compared the results with each other and with the results of experimental investigations. Finally, the Working Group came up with some conclusions and the recommendations for the application of a simplified semi-empirical method for a specific impulse prediction accuracy of 1%. Author

23 CHEMISTRY AND MATERIALS (GENERAL)

N87-18611*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPECTROSCOPIC COMPARISON OF EFFECTS OF ELECTRON RADIATION ON MECHANICAL PROPERTIES OF TWO POLYIMIDES
Edward R. Long, Jr. and Sheila Ann T. Long Apr. 1987 21 p
(NASA-TP-2663; L-16200; NAS 1.60:2663) Avail: NTIS HC A02/MF A01 CSCL 11C

The differences in the radiation durabilities of two polyimide materials, Du Pont Kapton and General Electric Ultem, are compared. An explanation of the basic mechanisms which occur during exposure to electron radiation from analyses of infrared (IR) and electron paramagnetic resonance (EPR) spectroscopic data for each material is provided. The molecular model for Kapton was, in part, established from earlier modeling for Ultem (pp. 1293-1298 of IEEE Transactions on Nuclear Science, December 1984). Techniques for understanding the durability of one complex polymer based on the understanding of a different and equally complex polymer are demonstrated. The spectroscopic data showed that the primary radiation-generated change in the tensile properties of Ultem (a large reduction in tensile elongation) was due to crosslinking, which followed the capture by phenyl radicals of hydrogen atoms removed from gem-dimethyl groups. In contrast, the tensile properties of Kapton remained unchanged because radical-radical recombination, a self-mending process, took place. Author

N87-18612# Department of Energy, Washington, D. C. Office of Energy Research.
MATERIALS SCIENCES PROGRAMS, FISCAL YEAR 1986
Sep. 1986 278 p
(DE86-015957; DOE/ER-0295) Avail: NTIS HC A13/MF A01

The purpose of this report is to provide a convenient compilation and index of the DOE Materials Sciences Division programs. The report is divided into six sections. Section A contains all Laboratory projects, Section B has all contract research projects, Section C has projects funded under the Small Business Innovation Research Program, Sections D and E have information on DOE collaborative research centers, Section F gives distribution of funding, and Section G has various indexes. DOE

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

N87-18613*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SEAMLESS METAL-CLAD FIBER-REINFORCED ORGANIC MATRIX COMPOSITE STRUCTURES AND PROCESS FOR THEIR MANUFACTURE Patent Application
Raymond M. Bluck, inventor (to NASA) (Lockheed Missiles and Space Co., Sunnyvale, Calif.), Harold G. Bush, inventor (to NASA), and Robert R. Johnson, inventor (to NASA) Filed 21 Oct. 1986 10 p
(NASA-Case-LAR-13562-1; NAS 1.71:LAR-13562-1; US-Patent-Appl-SN-921572) Avail: NTIS HC A02/MF A01 CSCL 11D

The invention relates to seamless metal clad filament reinforced resin matrix composite tubular structures and processes for their manufacture and is particularly useful in the construction of spacecraft and space structures. Metal clad composites make a significant advancement over those composite systems being used for both spacecraft and aircraft; however, the material consolidation and tooling advances necessary to realize the potential of such metal clad composites had not hitherto been achieved. Accordingly, it is an object of this invention to provide an efficient method of producing seamless metal clad composite structures. A metallic outer sleeve is provided which is capable of enveloping a hollow metallic inner member having continuous reinforcing fibers attached to the distal end thereof. Inner member is then introduced into outer sleeve until inner member is completely enveloped by outer sleeve. A liquid matrix material is then injected into the space between inner member and outer sleeve. A pressurized heat transfer medium is flowed through the inside of inner member, thereby forming a fiber reinforced matrix composite material. The wall thicknesses of both inner member and outer sleeve are then reduced to the appropriate size by chemical etching, to adjust the thermal expansion coefficient of the metal-clad composite structure to the desired value. The novelty of this invention resides in the development of a efficient method of producing seamless metal clad fiber reinforced organic matrix composite structures. Author

N87-18614*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTATIONAL COMPOSITE MECHANICS FOR AEROSPACE PROPULSION STRUCTURES
Christos C. Chamis 1987 19 p Presented at the 3rd Space Systems Technology Conference, San Diego, Calif., 9-12 Jun. 1986; sponsored by the AIAA Previously announced in IAA as A86-40596
(NASA-TM-88965; E-3023; NAS 1.15:88965) Avail: NTIS HC A02/MF A01 CSCL 11D

Specialty methods are presented for the computational simulation of specific composite behavior. These methods encompass all aspects of composite mechanics, impact, progressive fracture and component specific simulation. Some of these methods are structured to computationally simulate, in parallel, the composite behavior and history from the initial fabrication through several missions and even to fracture. Select methods and typical results obtained from such simulations are described in detail in order to demonstrate the effectiveness of computationally simulating: (1) complex composite structural behavior in general, and (2) specific aerospace propulsion structural components in particular. Author

N87-18615*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CERAMIC MATRIX AND RESIN MATRIX COMPOSITES: A COMPARISON
Frances I. Hurwitz 1987 14 p Presented at the 32nd National SAMPE Symposium and Exhibition, Anaheim, Calif., 6-9 Apr. 1987
(NASA-TM-89830; E-3481; NAS 1.15:89830) Avail: NTIS HC A02/MF A01 CSCL 11D

The underlying theory of continuous fiber reinforcement of ceramic matrix and resin matrix composites, their fabrication, microstructure, physical and mechanical properties are contrasted. The growing use of organometallic polymers as precursors to ceramic matrices is discussed as a means of providing low temperature processing capability without the fiber degradation encountered with more conventional ceramic processing techniques. Examples of ceramic matrix composites derived from particulate-filled, high char yield polymers and silsesquioxane precursors are provided. Author

N87-18616*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FATIGUE DAMAGE ACCUMULATION IN VARIOUS METAL MATRIX COMPOSITES
W. S. Johnson Mar. 1987 67 p Submitted for publication
(NASA-TM-89116; NAS 1.15:89116) Avail: NTIS HC A04/MF A01 CSCL 11D

The purpose of this paper is to review some of the latest understanding of the fatigue behavior of continuous fiber reinforced metal matrix composites. The emphasis is on the development of an understanding of different fatigue damage mechanisms and why and how they occur. The fatigue failure modes in continuous fiber reinforced metal matrix composites are controlled by the three constituents of the system: fiber, matrix, and fiber/matrix interface. The relative strains to fatigue failure of the fiber and matrix will determine the failure mode. Several examples of matrix, fiber, and self-similar damage growth dominated fatigue damage are given for several metal matrix composite systems. Composite analysis, failure modes, and damage modeling are discussed. Boron/aluminum, silicon-carbide/aluminum, FP/aluminum, and borsic/titanium metal matrix composites are discussed. Author

N87-18617# Washington Univ., St. Louis, Mo.
DAMAGE ASSESSMENT IN COMPOSITES BY ACOUSTIC-ULTRASONIC TECHNIQUE Final Report, Sep. 1985 - Aug. 1986
W. T. Hahn Oct. 1986 3 p
(Contract N00014-85-K-0795)
(AD-A174054) Avail: NTIS HC A02/MF A01 CSCL 11/7

The damage development in cross-ply S-2 glass/epoxy laminates were assessed using acousto-ultrasonic (UA) and acoustic emission (AE) techniques. Acoustic emission and acousto-ultrasonic measurements gave early warnings of damage initiation before transverse cracks became visible. GRA

N87-18618# Lawrence Livermore National Lab., Calif.
BORON CARBIDE-ALUMINUM CERMETS
D. C. Halverson 3 Sep. 1986 4 p Presented at the Communication on the Material Science and Engineering Study Conference, Boston, Mass., 1 Dec. 1986
(Contract W-7405-eng-48)
(DE86-016008; UCRL-95119; CONF-861231-1) Avail: NTIS HC A02/MF A01

We have developed boron carbide-aluminum cermets by means of thermodynamic, kinetic, and processing studies. Our research indicates that boron carbide-aluminum cermets offer tailorable microstructures with designable properties through process control. This new class of cermets has the potential to become a very important material with wide industrial applications. DOE

N87-18619# Lawrence Livermore National Lab., Calif.
TITANIUM-ALUMINUM-BERYLLIUM SYSTEM POTENTIAL FOR METAL MATRIX COMPOSITES Quarterly Progress Report
L. A. Jacobson, L. E. Tanner, J. B. Mitchell, M. A. Wall, and R. G. Castro Apr. 1986 26 p
(Contract W-7405-eng-48)
(DE86-016085; UCID-20635-86-2) Avail: NTIS HC A03/MF A01

Compositions in the range where rapid solidification will produce mainly amorphous material do not appear to have potential as useful composites because of the large-volume fraction of intermetallic that forms when they crystallize. Titanium-rich Ti-Be alloys, including those with aluminum, form a ternary oxide phase quite readily when they are exposed to temperatures of 600 C and above. It remains to determine what effect, if any, this will have on surface oxidation and the removal of oxygen from solid solution. The Ti-10%Be-10%Al composition warrants further study because it retains its hardness after being exposed to high temperatures. Future work will concentrate on this alloy and on the previously identified aluminum-rich alloy Al-10%Be-4%Ti. DOE

N87-18620# Sandia National Labs., Albuquerque, N. Mex.
QUANTITATIVE DESCRIPTION OF IN SITU FIBER ORIENTATION STATE WITH IMAGE PROCESSING TECHNIQUES
R. C. Givler Oct. 1986 35 p
(Contract DE-AC04-76DP-00789)
(DE87-001867; SAND-86-0075) Avail: NTIS HC A03/MF A01

A method for the quantitative description of the orientation state for a planar distribution is presented. The method employs the techniques commonly associated with image processing analyses. The orientation state of several computer-generated fiber patterns is calculated with the digital method to assess its accuracy as compared with alternative optical techniques; a particular advantage of the proposed method over a purely optical scheme is the accuracy associated with digital techniques. DOE

N87-18621# Oak Ridge National Lab., Tenn.
HIGH TEMPERATURE THERMAL CONDUCTIVITY OF A CARBON-BONDED CARBON FIBER INSULATION
R. E. Pawel, W. P. Eatherly, J. M. Robbins, and D. L. McElroy 1986 4 p Presented at the 4th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 12 Jan. 1987
(Contract DE-AC05-84OR-21400)
(DE87-002419; CONF-870102-5) Avail: NTIS HC A02/MF A01

The thermal conductivity of fibrous materials such as CBCF involves temperature dependent contributions from both the solid and gaseous constituents. At higher temperatures, radiative heat transfer also becomes important. Each of these contributions depends not only upon the volume fraction of the solid component, but will vary according to the morphological details. Steady-state techniques have provided accurate measurements to 1400 K, and these results can be used for purposes of comparison and to test heat flow models. DOE

N87-18622# Research Inst. of National Defence, Stockholm (Sweden). Dept. 2.
STUDY OF EPOXY MATRICES FOR FIELD REPAIR OF CARBON FIBER/EPOXY STRUCTURES
Lars Svensson Oct. 1986 17 p In SWEDISH; ENGLISH summary
(FOA-C-20626-2.4; ISSN-0347-3694; ETN-87-99096) Avail: NTIS HC A02/MF A01

Seven epoxy matrices were compared. Laminated carbon fiber/epoxy test specimens were cut in different angles and joined with the matrix to be tested. The specimens were loaded in tension to failure. Two of the test specimens (of different manufacturers) give the best values of stress, both in the viscosity range 600 to 750 mPas, and hardening time/temperature of respectively 60 min/100 C and 120 min/85 C. Prepared specimens stored for 9 months show better strength than specimens not stored. ESA

N87-18623# Research Inst. of National Defence, Stockholm (Sweden). Dept. 2.
STUDY OF MATRIX MATERIALS FOR FIELD REPAIR OF CARBON FIBER LAMINATES
Jan-Ove Palm and Lars Svensson Oct. 1986 67 p In SWEDISH; ENGLISH summary
(FOA-C-20628-2.5; ISSN-0347-3694; ETN-87-99097) Avail: NTIS HC A04/MF A01

Epoxy resins were investigated regarding their ability for the repair of carbon fiber composites. A test procedure to compare their adhesive capacity was elaborated. Repairing of damaged laminates was evaluated by tensile strength testing. The measurements were too few to give a general conclusion, but one epoxy resin shows better results than the others. The repair must overlap the crack. Crack initiation and propagation are reviewed. ESA

N87-18624# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
FATIGUE AND FRACTURE OF Al/SiC METAL MATRIX COMPOSITE MATERIAL FOR GUN TUBE APPLICATIONS Final Report
N. E. Dowling and R. B. Brown 1 Sep. 1986 35 p
(Contract DAAA22-85-C-0246)
(PB86-242252; VPI-E-86-15) Avail: NTIS HC A03/MF A01 CSCL 11D

Continuous fiber Al/SiC metal matrix composite material has

been subjected to a series of preliminary mechanical tests. Fracture toughness in the longitudinal direction is around 40 ksi (sq root of in), and in the transverse direction around 20 ksi (sq root of in). The material appears to be quite resistant to fatigue crack growth, but prone to delamination in both static and cyclic loading. Additional study of the material is recommended. GRA

N87-18872*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
NUMERICAL STUDIES OF THE THERMAL DESIGN SENSITIVITY CALCULATION FOR A REACTION-DIFFUSION SYSTEM WITH DISCONTINUOUS DERIVATIVES
Jean W. Hou and Jeen S. Sheen *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 263-283 (For primary document see N87-18855 11-39)
(Grant NAG1-561)
Avail: NTIS HC A16/MF A01 CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N87-18625*# National Aeronautics and Space Administration. Pasadena Office, Calif.
ISOTOPE SEPARATION USING TUNED LASER AND ELECTRON BEAM Patent Application
Sandor Trajmar, inventor (to NASA) Filed 13 Nov. 1986 24 p (Contract NAS7-918)
(NASA-Case-NPO-16907-1-CU; US-Patent-Appl-SN-930217; NAS 1.71:NPO-16907-1-CU) Avail: NTIS HC A02/MF A01 CSCL 20H

High selectivity and economy have been attained by the apparatus of the present invention for producing and separating a stream of a selected isotope from an atomic beam containing a mixture of isotopes comprising means for producing an atomic beam containing the isotope of interest and other isotopes. Means are provided for producing a magnetic field traversing the path of the atomic beam of an intensity sufficient to broaden the energy domain of the various individual magnetic sublevels of the isotope of interest and having the atomic beam passing therethrough. A laser beam is produced of a frequency selected to maximize the activation of only individual magnetic sublevels of the isotope of interest within the portion of its broadened energy domain most removed from other isotopes within the beam. The laser beam is directed so as to strike the atomic beam within the magnetic field and traverse the path of the atomic beam whereby only the isotope of interest is activated by the laser beam. The apparatus further includes means for producing a collimated and high intensity beam of electrons of narrow energy distribution within the magnetic field which is aimed so as to strike the atomic beam while the atomic beam is simultaneously struck by the laser beam and at an energy level selected to ionize the activated isotope of interest but not ground state species included therein. Finally, deflection means are disposed in the usual manner so as to have the atomic beam pass therethrough after being struck by the electron beam so that the ionized isotope is deflected from the remainder of the beam to form a separate stream composed only of the isotope of interest. NASA

N87-18626*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHOD AND DEVICE FOR DETERMINING HEATS OF COMBUSTION OF GASEOUS HYDROCARBONS Patent Application
Jag J. Singh, inventor (to NASA), Danny R. Sprinkle, inventor (to NASA), and Richard L. Puster, inventor (to NASA) Filed 24 Nov. 1986 16 p
(NASA-Case-LAR-13528-1; NAS 1.71:LAR-13528-1; US-Patent-Appl-SN-933962) Avail: NTIS HC A02/MF A01 CSCL 21B

A method and device is provided for a quick, accurate and on-line determination of heats of combustion of gaseous hydrocarbons. First, the amount of oxygen in the carrier stream air is sensed by a oxygen sensing system. Second, three individual volumetric flow rates of oxygen, carrier stream air, and hydrocarbon test gas are introduced into a burner. The hydrocarbon test gas is fed into the burner at a volumetric flow rate, n, measured by a flowmeter. Third, the amount of oxygen in the resulting combustion products is sensed by an oxygen sensing system. Fourth, the volumetric flow rate of oxygen is adjusted until the amount of oxygen in the combustion product equals the amount of oxygen previously sensed in the carrier stream air. This equalizing volumetric flow rate, m, is measured by the flowmeter. The heat of combustion of the hydrocarbon test gas is then determined from the ratio m/n. NASA

N87-18627*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MOVING WALL, CONTINUOUS FLOW ELECTROPHORESIS APPARATUS Patent Application
Percy H. Rhodes, inventor (to NASA) Filed 5 Sep. 1986 17 p (NASA-Case-MFS-28142-1; NAS 1.71:MFS-28142-1; US-Patent-Appl-SN-904128) Avail: NTIS HC A02/MF A01 CSCL 07D

This invention relates generally to electrophoresis devices and more particularly to a moving wall, continuous flow device wherein an electrophoresis chamber is angularly positionable with respect to the direction of moving belt walls. A frame having an electrophoresis chamber is rotatably supported between two synchronously driven belt walls. This allows the chamber to be angularly positionable with respect to the direction of belt travel, which compensates for electroosmatic flow within the electrophoresis chamber. Injection of a buffer solution via an opening and a homogenous sample stream via another opening is performed at end of a chamber, and collection of buffer and the fractionated species particles is done by a conventional collection array at an opposite end of the chamber. Belts are driven at a rate which exactly matches the flow of buffer and sample through the chamber, which entrains the buffer to behave as a rigid electrophoretic medium, eliminating flow distortions (Poiseuille effect). Additionally, belt material for each belt is stored at one end of the device and is taken up by drive reels at an opposite end. The novelty of this invention particularly lies in the electrophoresis chamber being angularly positionable between two moving belt walls in order to compensate for electoosmatic flow. Additionally, new belt material is continuously exposed within the chamber, minimizing flow distortions due to contamination of the belt material by the sample. Author

N87-18628# California Univ., Berkeley. Dept. of Mechanical Engineering.
PERTURBED BOUNDARY LAYER DIFFUSION FLAMES Ph.D. Thesis
James Alfred Ang Mar. 1987 137 p
(Grant NBS 60NANB5D0552)
(NBS-GCR-87-526) Avail: NTIS HC A07/MF A01

Thermal cracking is shown to have a significant effect on the temperature profiles in a boundary layer diffusion flame. Measurements of temperature profiles in a sooting free flow flame are compared with classic flame sheet model results. This comparison reveals a large overprediction of temperatures in the region between the fuel surface and the flame. The principle cause of this overprediction is the neglect of thermal cracking in the flame sheet model. The endothermicity of the cracking phenomena is analytically treated in a forced flow flame through the introduction of new Shvab-Zeldovich variables and a simple cracking sheet model, analogous to the flame sheet model. Two new parameters D sub cr and Q' are found which control the temperature at which cracking occurs and the amount of energy absorbed in the process. A second possible cause for the temperature overprediction is the sink effect of radiative heat transfer from soot in the boundary

layer. This effect and the effects of wall emission and normal buoyancy on a horizontal boundary layer diffusion flame are studied by perturbing the cracking sheet solution. The principle effect of soot radiation is an increased blowing rate at the wall. This blowing is offset by the radiative wall emission. The postulated sink effect of soot emission is negligible. The major buoyancy effect is primarily the inducement of a velocity overshoot. Author

N87-18629*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ELECTRON STIMULATED DESORPTION OF ATOMIC OXYGEN FROM SILVER
R. A. Outlaw, W. K. Peregoy, Gar B. Hoflund (Florida Univ., Gainesville), and Gregory R. Corallo Apr. 1987 25 p
(NASA-TP-2668; L-16225; NAS 1.60:2668) Avail: NTIS HC A02/MF A01 CSCL 07D

The electron stimulated desorption (ESD) of neutral oxygen atoms from polycrystalline silver and of oxygen ions from Ag(110) has been studied. Polycrystalline Ag charged with (16)O2 and (18)O2 and bombarded by low-energy electrons (approx 100 eV) under ultrahigh vacuum (UHV) conditions emitted O atom flux levels of 1 x 10 to the 12th power/sq cm/s at a Ag temperature of 300 C. The flux was detected with a quadrupole mass spectrometer operating in the appearance potential mode. The neutral cross section at about 100 C was determined to be 7 x 10 to the -19 sq cm. Ancillary experiments conducted in a UHV chamber equipped with a cylindrical mirror analyzer and rigged for ion energy distribution and ion angular distribution were used to study O ions desorbed from Ag(110). Two primary O(+) energies of 2.4 and 5.4 eV were detected from the Ag(110) after having been dosed with 2500 L of (16)O2. It also appears that in both experiments there was strong evidence for directionality of the emitted flux. The results of this study serve as a proof of concept for the development of a laboratory atomic oxygen beam generator that simulates the gas flux environment experienced by orbiting vehicles. Author

N87-18630# Argonne National Lab., Ill.
DYNAMIC BEHAVIOR OF REACTING GAS JETS SUBMERGED IN LIQUIDS: A PHOTOGRAPHIC STUDY Annual Report, 1 May 1985 - 1 May 1986
D. H. Cho, D. R. Armstrong, and L. Bova Sep. 1986 46 p
(Contract N00014-85-F-0086)
(AD-A173936; ANL-86-41) Avail: NTIS HC A03/MF A01 CSCL 21/2

A photographic study of hydrogen chloride gas jets reacting in an aqueous solution of ammonia was conducted. The high-speed motion pictures taken revealed that the behavior of the reacting gas jet was highly dynamic and complex. The gaseous jet penetration (plume) was not stationary, but underwent a change in shape and size with time, which appeared to be periodic or cyclic. Certain observations made, including a high-pitched sound, exhibited a striking similarity to the so-called singing flame phenomenon. Such dynamic plume behavior is attributed to the vaporization of the beta liquid due to reaction heat release. The plume length measurements for large concentrations of ammonia seem to confirm the prediction that when the extent of vaporization is large, the plume length is mainly determined by the distance required for condensation of the vapor. GRA

N87-18631# Boeing Aerospace Co., Seattle, Wash.
X-RAY ABSORPTION SPECTROSCOPY OF GAS PHASE METAL CLUSTERS
Edward C. Marques, Darin S. Olson, Donald R. Sandstron, Farrel W. Lytle, and Robert B. Greegor 31 Oct. 1986 9 p
(Contract N00014-85-C-0207)
(AD-A174010; TR-3) Avail: NTIS HC A02/MF A01 CSCL 07/4

The production and control of vapor phase metal clusters in sizes ranging from one to thousands of atoms is discussed. Electron yield detection has a very high sensitivity to species in the gas phases. These events suggested the possibility of a combined experiment; in-situ X-ray absorption study of evaporated metal in gas phase. The comparison of gas phase results to earlier work on supported metal catalysis would be very helpful in determining the extent of support interaction. In addition, new information gathered from experiments where gas phase metal atoms or clusters are reacted with molecules, such as H2O, Cl, NH3 etc., would improve our understanding of transition metal coordination chemistry. Trial experiments were completed at SSRL using a preliminary design for the metal vapor cell/detector. A resistance heated evaporation source was positioned so that metal vapor (in this case Cu) would flow directly through the electron detection grids, while the X-ray beam crossed through the vapor between the grids. The results suggested some improvements to the evaporator design which would result in better electrical isolation and less contamination of insulators. The newer design will also have better vacuum pumping characteristics and a longer path for X-rays through the vapor. GRA

N87-18632# Delaware Univ., Newark. Dept. of Chemistry.
STRUCTURE/PROPERTY/REACTIVITY RELATIONSHIPS AMONG NITRAMINES AND NEWER ENERGETIC MATERIALS Final Report, 1 Oct. 1985 - 30 Sep. 1986
Thomas B. Brill 6 Oct. 1986 14 p
(Grant AF-AFOSR-0353-85)
(AD-A174419; AFOSR-86-1088TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

Rapid-scan infrared spectroscopy studies of the high rate thermolysis of energetic molecules containing CNO2, NNO2, ONO2, N3, NO3(-), IR spectroscopy, DSC, solid-state NMR and X-ray crystallography have been conducted. Structure/property/reactivity relationships have been established for the formation of NO2 and HONO. Understanding of some of the factors influencing the formation of CH2O, N2O and NO has also been acquired. The influence of the static applied pressure on the first observed decomposition products has been explored successfully. GRA

N87-18633# United Technologies Research Center, East Hartford, Conn.
SATURATION AND SPECTRAL LINE BEHAVIOR IN THE RESONANT CARS SPECTRUM OF OH Final Report, 1 Dec. 1984 - 30 Apr. 1986
J. F. Verdieck and L. R. Boedeker 30 May 1986 35 p
(Contract F49620-85-C-0014)
(AD-A174436; UTRC/R86-957058F; AFOSR-86-1087TR) Avail: NTIS HC A03/MF A01 CSCL 07/4

The origins of the unpredicted satellite lines about the central resonance of the CARS spectrum found in a previous study have been explored. The objectives of the program were to determine the dependence of the line structure on the input laser intensities and on tuning of the resonant frequency. In the previous AFOSR-supported study, electronically resonant coherent anti-Stokes Raman spectroscopy (CARS) of OH was demonstrated for the first time using a flame source. Theory and experiment were in generally good agreement, except for the presence of satellite lines (extra resonances) about the strong central component. In order to investigate reliably the power dependence of the resonance CARS spectrum and thereby test for saturation effects, a single mode, pulsed, tunable dye laser was utilized to insure selective excitation of a single resonance. The resultant spectra show clearly that saturation occurs at input laser pulse energies of the resonant frequency of about 0.1 millijoules. Saturation effects are particularly apparent when the CARS pump frequency is on line center of the selected electronic transition. Tuning away from line center and/or reducing input pulse energy produces a notable decrease in the strength of the satellite lines relative to the central peak. The frequency splitting between the satellite components was determined to be independent of laser intensity and the tuning of the resonant CARS pump frequency relative to line center. GRA

N87-18634# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemical and Environmental Engineering.
COMBUSTION KINETICS OF METAL OXIDE AND HALIDE RADICALS AND METAL ATOMS Final Report, 1 Dec. 1981 - 30 Nov. 1985

Arthur Fontijn 28 Jan. 1986 14 p
(Grant AF-AFOSR-0073-82; AF Proj. 2308)
(AD-A174479; AFOSR-86-0855TR) Avail: NTIS HC A02/MF A01 CSCL 21/2

To provide a better understanding of the temperature dependence of the kinetics of diatomic metal radical oxidation reactions, experimental measurements were made in the 450 to 1750 K temperature regime. An HTFFR (high-temperature fast-flow reactor) was used. The metal radical concentrations were measured by laser-induced fluorescence. The general uses of this spectrometric technique for rate measurements on reactants and products, as well as for product species identification and product state determination, are reviewed. The radicals studied in the HTFFR on this grantwere ALO, AlCl and BCl. Production methods for these are discussed. For the reaction AlO + CO yields AlO2 AlO + AlO2 + CO we obtain k(T) = 2.5 X 10 to the minus 14th power exp (400/T) cc/molecules/s. This negative activation energy implies D(O-AlO) geater than D(O-CO) = 530 kj/mol, which is in apparent disagreement with the OAlO dissociation energy obtained for AlO2 from Al2O3 evaporation-mass spectrometry studies. It is argued that the latter AlO2 may have a different structure from that of the present work. For the reaction between AlCl and O2 we find k(T) = 6.8 X 10 to the minus 13th power exp(-2990/T) + 1.5 X 10 to the minus tenth exp(-10600/T) cc/mol/s, which is compatible with a mechanism where the Al02 + Cl product channel dominates at lower temperatures, while the OAlCl + O channel dominates at higher temperatures. The ln k(T) versus dependence of the AlCl/O2 reaction is contrasted to those observed for the AlO/O2 and BF/O2 reactions. GRA

N87-18635# Chemical Research and Development Center, Aberdeen Proving Ground, Md.
PRINCIPLES AND PROCEDURES FOR THE EVALUATION OF CHEMICAL AND BIOCHEMICAL SENSORS DURING EXPLORATORY DEVELOPMENT Technical Report, Jan. - Sep. 1985
Brent R. Busey and Kenneth E. Thamnes Oct. 1986 28 p
(AD-A174734; CRDEC-TR-87001) Avail: NTIS HC A03/MF A01 CSCL 07/4

Many chemical and biochemical sensors transduce a chemical or physical surface phenomenon, such as an oxidation/reduction process, an immunological binding event, or a physical absorption, into an electrical signal. This report describes principles and procedures to characterize such sensors and includes information pertinent to electrochemical, optical, and piezoelectric sensors. Concepts dealing directly with the transduction mechanisms and sensor operation are discussed. Peripheral concerns such as designing a sensor system to be adaptable to new applications are also discussed. GRA

N87-18636# Tennessee Univ., Knoxville. Dept. of Physics and Astronomy.
VACUUM ULTRAVIOLET ELECTRONIC PROPERTIES OF LIQUIDS Progress Report, 1 Feb. 1986 - 31 Jan. 1987
L. R. Painter Jul. 1986 12 p
(Contract DE-FG05-86ER-60415)
(DE86-014678; DOE/ER-60415/1) Avail: NTIS HC A02/MF A01

The work on optical and photoionization measurements on ethylene glycol, diethylene glycol, triethylene glycol and tetraethylene glycol was recently completed. Studies were completed on absolute photoyield of this series of four n-ethylene glycols. Studies on doping of electrically insulating liquids which had displayed little if any photoemission were conducted. The addition of alkali salts to the linear aldanes pentadecane and heptadecane revealed no statistically significant change in photoemission, despite observed increases in conductivity. This confirmed earlier preliminary measurements on ionic doping reported for squalane and tetraethylene glycol. Comcomitant with this experimental effort, theoretical studies based on diffusion of charge carriers on the surface of liquids were initiated. A major thrust of the current contract period has been the introduction of discharge needles and submerged conductors in the liquid to reduce the effects of surface charge. Photoemission from liquids previously showing no measurable yield demonstrates the placibility of using grids near a liquified surface to effect discharge. These studies are ongoing as appropriate grid configurations are examined. DOE

N87-18637# California Univ., Berkeley.
CHARACTERISATION OF INORGANIC MATERIALS
G. Thomas Dec. 1985 19 p Presented at the 11th International Congress on Electron Microscopy, Kyoto, Japan, 31 Aug. 1986
(Contract DE-AC03-76SF-00098)
(DE86-015203; LBL-21332; CONF-860854-4) Avail: NTIS HC A02/MF A01

Examples are given of research using the wide range of techniques available in modern electron microscopes. Ceramics, metals, semiconductors are covered. DOE

N87-18638# North Carolina Central Univ., Durham.
VIBRATIONAL PROPERTIES OF DISORDERED SOLIDS: FAR INFRARED STUDIES Progress Report
C. R. Jones 18 Aug. 1986 6 p
(Contract DE-FG05-84ER-45126)
(DE87-000649; DOE/ER-45126/2) Avail: NTIS HC A02/MF A01

Measurements are reported for the following: boron nitride, beryllia, alumina, silicon nitride, nickel-ferrite, silicon, quartz, sapphire, fused silica, Rexolite, TPX, polyethylene, and Ferroflow. DOE

N87-18639# California Univ., Los Angeles. Dept. of Chemistry and Biochemistry.
METALLACARBORANES STRUCTURALLY ENGINEERED FOR THE REDUCTION OF CARBON MONOXIDE Final Project Report
M. F. Hawthorne 1986 26 p
(Contract DE-AS03-80ER-10673)
(DE87-000657; DOE/ER-10673/T4) Avail: NTIS HC A03/MF A01

The research conducted under this Department of Energy contract has involved the development and evaluation of various metallacarborane complexes as homogeneous catalysts for the transformation of carbon monoxide into useful chemical products. The discussions presented herein summarize our results in several areas of primary interest: (1) the evaluation of the activity of certain rhoda- and ruthenacarborane complexes as catalyst precursors for the water gas shift reaction; (2) the synthesis of heterobimetallic metallacarboranes which possess both early and late transition metal vertices; and (3) the preparation of a series of rhodacarborane complexes which have potential for use in catalysis. DOE

N87-18640# Brigham Young Univ., Provo, Utah.
THERMODYNAMIC PROPERTIES OF SUPERCRITICAL MIXTURES Progress Report, 15 Mar. 1985 - 31 Aug. 1986
J. J. Christensen and R. M. Izatt 30 Sep. 1986 10 p
(Contract DE-FG02-85ER-13443)
(DE87-000871; DOE/ER-13443/1) Avail: NTIS HC A02/MF A01

The primary goal of this research effort is to gain increased understanding of the energetics associated with chemical and physical interactions involving supercritical and near-supercritical fluids. Emphasis has been placed on reactions involving CO, fluorocarbons, and hydrocarbon. Heat of mixing (H sub E) values have been determined for several binary systems involving these three classes of compounds and manuscripts have been prepared which report the experimental results. The flow calorimeter has been modified to allow ternary systems to be studied. The system (CO + hexane) with the additive CH OH(5%) has been studied at 300 K and 12.5 MPa. DOE

N87-18641# Imperial Coll. of Science and Technology, London (England). Computational Fluid Dynamics Unit.
STUDIES IN UNSTEADY FLAME PROPAGATION Ph.D. Thesis
Z. Y. Wu Aug. 1986 307 p Sponsored by the Education Ministry of China, and the Health and Safety Executive of Great Britain
(CFDU/86/9; ETN-87-99129) Avail: NTIS HC A14/MF A01

Unsteady flame propagation through a premixed combustible gas was studied. Photographs and qualitative descriptions of the

flame wrinkling in a vented combustion chamber are presented. The single-fluid approach developed by Spalding and Awn (1978) is refined to simulate wrinkled laminar flames. Predictions are compared with photographs of propagating flames, and agreement in trends is found. The approach is used to obtain information on the flame wrinkling in simpler circumstances. The Spalding two-fluid model of turbulent combustion is applied to a one-dimensional, unsteady, confined, premixed flame with an idealized character. The experimentally observed features of combustion oscillations are plausibly simulated with qualitative realism. The buzz phenomenon is explained. ESA

N87-18642*# National Academy of Sciences - National Research Council, Washington, D. C.
PHYSICS THROUGH THE 1990s: ATOMIC, MOLECULAR AND OPTICAL PHYSICS
1986 190 p Sponsored by NASA, DOD, DOE and NSF
(NASA-CR-180052; NAS 1.26:180052; PB86-241502; ISBN-0-309-03575-9; LC-85-11524) Avail: NTIS HC A09/MF A01 CSCL 07D

The volume presents a program of research initiatives in atomic, molecular, and optical physics. The current state of atomic, molecular, and optical physics in the US is examined with respect to demographics, education patterns, applications, and the US economy. Recommendations are made for each field, with discussions of their histories and the relevance of the research to government agencies. The section on atomic physics includes atomic theory, structure, and dynamics; accelerator-based atomic physics; and large facilities. The section on molecular physics includes spectroscopy, scattering theory and experiment, and the dynamics of chemical reactions. The section on optical physics discusses lasers, laser spectroscopy, and quantum optics and coherence. A section elucidates interfaces between the three fields and astrophysics, condensed matter physics, surface science, plasma physics, atmospheric physics, and nuclear physics. Another section shows applications of the three fields in ultra-precise measurements, fusion, national security, materials, medicine, and other topics. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N87-18643*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE ALLOY UNDERCOOLING EXPERIMENT ON THE COLUMBIA STA 61-C SPACE SHUTTLE MISSION
Fredric H. Harf, Thomas J. Piccone (Massachusetts Inst. of Tech., Cambridge), Yanzhong Wu, Merton C. Flemings, Yuh Shiohara, Lloyd B. Gardner (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.), and Edward A. Winsa 1987 38 p Presented at the 25th Aerospace Sciences Meeting, Reno, Nev., 12-15 Jan. 1987; sponsored by AIAA
(NASA-TM-88909; E-3332; NAS 1.15:88909) Avail: NTIS HC A03/MF A01 CSCL 11F

An Alloy Undercooling experiment was performed in an electromagnetic levitator during the Columbia STS 61-C mission in January 1986. One eutectic nickel-tin alloy specimen was partially processed before an equipment failure terminated the experiment. Examination of the specimen showed evidence of undercooling and some unusual microstructural features. Author

N87-18644*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF LID (REGISTERED) PROCESSING ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF Ti-6Al-4V AND Ti-6Al-2Sn-4Zr-2Mo TITANIUM FOIL-GAUGE MATERIALS
Linda B. Balckburn Apr. 1987 27 p
(NASA-TP-2677; L-16098; NAS 1.60:2677) Avail: NTIS HC A03/MF A01 CSCL 11F

A study was undertaken to determine the mechanical properties and microstructures resulting from Liquid Interface Diffusion LID-Registered) processing of foil-gauge specimens of Ti-6Al-4V and Ti-6Al-2Sn-4Zr-2Mo coated with varying amounts of LID material. In addition, the effects of various elevated temperature exposures on the concentration profiles of the LID alloying elements were investigated, using specimens with a narrow strip of LID material applied to the surface. Room and elevated temperature tensile properties were determined for both coated and uncoated specimens. Optical microscopy was used to examine alloy microstructures, and scanning electron microscopy to examine fracture surface morphologies. The chemical concentration profiles of the strip-coated specimens were determined with an electron microprobe. Author

N87-18645# Naval Postgraduate School, Monterey, Calif.
THE VARIATION OF SUBGRAIN MISORIENTATION IN ALUMINUM WITH LARGE STEADY-STATE CREEP STRAIN M.S.BAD CAPS LANGUAGE[en] Thesis
Michael E. McMahon Jun. 1986 73 p
(AD-A174321) Avail: NTIS HC A04/MF A01 CSCL 11/6

High purity aluminum was torsionally deformed to various strains up to 16.33 at a temperature of 644 K in this study. The variation in the dislocation substructure was determined with increasing strain. Recent work revealed that both the subgrain size and density of dislocations not associated with subgrain boundaries remained constant over the range of steady-state strains examined. However, transmission electron microscopy in this work revealed that subgrain boundaries remained constant over the range of steady-state strains examined. However, transmission electron microscopy in this work revealed that subgrain boundaries undergo two types of basic changes during steady-state creep. At the onset of steady-state behavior (epsilon = 0.20) all subgrain boundaries had small misorientations, typically, 0.6. The misorientation across boundaries formed as a result of dislocation accumulation continued to increase well past steady-state up to a strain of about 1.2, where a maximum average value of 1.2 was observed. This suggests that the dislocation spacing in subgrain boundaries is not principally responsible for the creep resistance during five power-law creep. At strains greater than about four, nearly a third of the subgrain boundaries were determined to be high angle boundaries (HAB). GRA

N87-18646# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Metallurgical Engineering and Materials Science.
STRESS CORROSION CRACKING OF WROUGHT AND P/M HIGH STRENGTH ALUMINUM ALLOYS Final Technical Report, 24 Aug. 1981 - 30 Jun. 1986
A. W. Thompson and I. M. Bernstein 1 Sep. 1986 23 p
(Grant AF-AFOSR-0041-81)
(AD-A174435; MEMS-AL-9; AFOSR-86-1090TR) Avail: NTIS HC A02/MF A01 CSCL 11/6

The major findings from a comprehensive study on the role of microstructure on the susceptibility to environmental embrittlement of high strength aluminum alloys are presented and discussed. Most of the studies used commercial 7075, or a high purity equiaxed version, HP7075, or a similar powder version 7090. Through the innovative use of loading mode and straining electrode test, stress corrosion cracking was shown to be controlled by the introduction and internal distribution of hydrogen, particularly to grain boundaries. This was the case for the underaged and peak aged microstructures, with the latter being the most susceptible. The SCC behavior of the even more resistant overaged microstructure was shown to be controlled by anodic dissolution processes, predominantly associated with slip bands. Aluminum alloys were also shown to be susceptible to embrittlement under conditions of cathodic polarization correcting a widely held belief that concomitant anodic processes are required. Studies using controlled microstructures were able to rank the importance of different microstructural features to help develop alloy design strategies for more environmentally resistant alloys -- the most effective features are those grain interior precipitates which promote fine, homogen-

eous slip either by reduced particle cutting or enhanced dislocation generation; fine, grain boundary precipitate free zones were found not to be very important, except in their role in reducing the local strength. GRA

N87-18647# Royal Aircraft Establishment, Farnborough (England).
EFFECT OF AGEING TEMPERATURE ON THE MECHANICAL AND STRESS CORROSION PROPERTIES OF CARPENTER CUSTOM 455 STAINLESS STEEL
T. S. Baker Nov. 1985 24 p
(AD-A174660; RAE-TM-MAT-STR-1072; DRIC-BR-99816) Avail: NTIS HC A02/MF A01 CSCL 11/6

Tensile, impact fracture toughness and stress corrosion properties of CC 455 alloy steel were determined on bar stock for four different heat treatment conditions. Although mechanical property results showed good agreement with those obtained by other workers, stress corrosion tests on smooth tensile test pieces exhibited failure at stresses similar to and lower than those previously reported. DOE

N87-18648# Oak Ridge National Lab., Tenn.
NEW CLASS OF ALLOYS FOR HIGH-TEMPERATURE APPLICATIONS
V. K. Sikka and J. R. Weir, Jr. 1986 39 p
(Contract DE-AC05-84OR-21400)
(DE86-015932; ORNL/M-167) Avail: NTIS HC A03/MF A01

Ni Al alloys and their modifications are the subject of interest. This report comprises graphs and tables of the general properties of NiAl, additions of B, comparisons with other alloys, potential applications and industrial interest, fabrication, microstructure, mechanical properties, and products. DOE

N87-18649# Sandia National Labs., Albuquerque, N. Mex. Thermomechanical and Physical Div.
DYNAMIC QUASI-ISENTROPIC COMPRESSION TECHNIQUES: APPLICATIONS TO ALUMINUM AND TUNGSTEN
L. C. Chhabildas and L. M. Barker Aug. 1986 26 p
(Contract DE-AC04-76DP-00789)
(DE86-016027; SAND-86-1888) Avail: NTIS HC A03/MF A01

A novel impact technique involving the use of a pillow to obtain quasi-isentropic loading in materials is reported. A pillow is fabricated using powder metallurgical and sedimentation techniques, such that a smooth variation in shock impedance across its thickness results. This variation in shock impedance as a function of thickness gives rise to a finite rate of loading at the impact interface when the pillow is used as an impactor. The pillow can be used with smooth bore guns to introduce nearly isentropic loading states in a target material. The usefulness and the success of this technique have been demonstrated by using it in an equation-of-state study of 6061-T6 aluminum to 9 GPa and of tungsten to 78 GPa. In each instance, it is observed that the quasi-isentrope lies above the Hugoniot, contrary to initial expectations. The results indicate that the dynamic yield strength of the material is dependent on the loading rate with the strength of the material being higher for the relatively slower rates of isentropic loading than for shock loading. The techniques reported herein, when used in conjunction with the two-stage light-gas gun, will potentially allow the determination of loading isentropes to Megabar stresses. DOE

N87-18650# California Univ., Davis. Div. of Materials Science and Engineering.
DETECTION OF HYDROGEN EMBRITTLEMENT IN METALS Final Report
J. F. Shackelford and B. Bay Sep. 1986 26 p
(Contract W-7405-eng-48)
(DE86-016142; UCRL-15842) Avail: NTIS HC A03/MF A01

A filtered neutron radiography system for enhanced hydrogen detection has been simulated for the purpose of minimizing experimental testing requirements. Initial simulations were made on a filter/foil combination from the literature (cadmium-indium/indium). Comparable simulations were made on cadmium/cadmium and gadolinium/gadolinium filter/foil systems. Results indicate that a trade-off exists between efficiency and sensitivity, with the gadolinium system proving intermediate hydrogen detectability and speed of exposure. DOE

N87-18651# Sandia National Labs., Albuquerque, N. Mex.
THEORETICAL EQUATION OF STATE FOR ALUMINUM
G. I. Kerley 21 Oct. 1986 17 p Presented at the Hypervelocity Impact Symposium, San Antonio, Tex., 21 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE86-014148; SAND-86-1779C; CONF-861091-5) Avail: NTIS HC A02/MF A01

Theoretical methods for calculating equations of state (EOS) are discussed and applied to aluminum. The model includes a treatment of melting, vaporization, and thermal electronic excitation. The thermal electronic terms are found to be important in predicting the behavior of the hot expanded fluid. Good agreement with experimental data is obtained. DOE

N87-18652# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
HYDROGEN ATTACK IN Cr-Mo STEEL AT ELEVATED TEMPERATURES Final Technical Report, 1 Sep. 1983 - 31 Aug. 1985
D. Stone, S. Ruoff, J. Wanagel, and C. Y. Li 1985 60 p
(Contract DE-AC05-84OR-21400)
(DE86-015561; ORNL/Sub-80-7963/01) Avail: NTIS HC A04/MF A01

The work found that a 3 Cr-1.5 Mo steel exhibited a significantly improved hydrogen attack resistance under accelerated testing conditions compared to 2.25 Cr-1 Mo steels. The effects of cold work, welding processes, and applied stresses were found also not to be important under the same test conditions. The improved hydrogen attack resistance is related to the absence of lower carbides of the MC type in this class of materials. Additional work was performed on 2.25 Cr-1 Mo steels to show their susceptibility to hydrogen attack. The improved performance of a 3 Cr-1.5 Mo steel suggests the potential use of this class of materials in hydrogen service at elevated temperatures. DOE

N87-18653# Pacific Northwest Labs., Richland, Wash.
CORROSION-RESISTANCE CHARACTERISTICS OF SPUTTERED TITANIUM-HASTELLOY C GLASSY ALLOY COATINGS
G. M. Faldetta Aug. 1986 23 p
(Contract DE-AC06-76RL-01830)
(DE86-015815; PNL-5984) Avail: NTIS HC A02/MF A01

The corrosion-resistance characteristics of sputtered titanium (Ti)-Hastelloy C glassy alloy coatings were studied in 1 N HCl solution by potentiodynamic polarization methods. The sputtered Ti-Hastelloy C glassy alloy coatings had excellent corrosion resistance, similar to that of sputtered and heat-treated tungsten stainless steel (W-304 SS) glassy alloys. More significantly, an optimum atom percent of Ti in the sputtered Ti-Hastelloy C glassy alloy coatings for the desired corrosion-resistance characteristics was determined. DOE

N87-18654# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
CHARACTERIZATION OF RAPIDLY SOLIDIFIED TYPE 304 STAINLESS STEEL POWDER
R. N. Wright, J. E. Flinn, and G. E. Korth Apr. 1986 51 p
(Contract DE-AC07-76ID-01570)
(DE87-000470; EGG-SCM-7133) Avail: NTIS HC A04/MF A01

The microstructure, morphology, size distribution and surface characteristics of rapidly solidified Type 304 stainless steel powders produced by centrifugal atomization and vacuum gas atomization have been characterized. Both powders are generally spherical with average particle sizes of 40 and 80 m for the CA and VGA powders respectively. The CA powder forms an iron oxide layer about 2.5 nm thick and the VGA powder forms an iron-chromium oxide layer about 8.0 nm thick. The CA powder contains a significant amount of helium which is entrained during processing, and the retained helium is stable with respect to outgassing up to the melting point of the powder. Both CA and VGA powders contain a metastable bcc phase which is retained at room temperature.

The volume fraction of bcc phase increases with decreasing particle size in the CA powder. The volume fraction of bcc does not depend strongly on the particle size in the VGA powder, but there is a trend for larger volume fraction of bcc with increasing particle size. Solidification as primary austenite is favored in the larger CA parti cles which contain potent catalytic sites for heterogeneous nucleation of the solid, and therefore solidify with relatively shallow undercooling. DOE

N87-18655# California Univ., Davis. Div. of Materials Science and Engineering.
ADHESION OF PVD INTERMEDIATE LAYERS IN SOLID STATE BONDING APPLICATIONS Final Report
C. Schalansky and Z. A. Munir Dec. 1985 81 p
(Contract W-7405-eng-48)
(DE87-001305; UCRL-15841) Avail: NTIS HC A05/MF A01

The conditions prevailing during the deposition of thick metallic films by the hot-hollow cathode method were investigated. The spatial distribution of temperature, surface roughness, and depth of etch during the pre-deposition etching cycle was investigated for two different sample holder designs. The influence of substrate temperature and the angle of incidence of the vapor on the structure and adhesion of thick silver films to type 304 stainless steel was determined. The nature and strength of adhesion were evaluated on the basis of microscopic examinations and tensile test determinations. Similar evaluations were made on tensile test samples formed through electroplating copper and nickel onto the silver films instead of the joining of two silver-coated samples by hot-isostatic pressing. DOE

N87-18656# Brookhaven National Lab., Upton, N. Y.
STUDY OF THE INHIBITION OF CORROSION OF ALUMINIUM BY CHROMATES USING FLUORESCENCE DETECTION OF X-RAY ABSORPTION
J. K. Hawkins (Manchester Univ., England), H. S. Isaacs, S. M. Heald, J. Tranquada, G. E. Thompson, and G. C. Wood 1986 10 p Presented at the 169th Meeting of the Electrochemical Society, Boston, Mass., 4 May 1986
(Contracts DE-AC02-76CH00016; DE-AS05-80ER-10742)
(DE87-001375; BNL-38623; CONF-860540-7) Avail: NTIS HC A02/MF A01

Fluorescence detection of x-ray absorption has been employed to gain further insight into the interaction of chromate species with aluminum specimens supporting films of controlled thickness; of particular importance, the amounts and locations of Cr VI and Cr III species require further clarification. Absorption spectra from standards show marked differences between Cr III and Cr VI states, indicating the potential of the technique in such inhibitor studies. After natural immersion of the aluminum specimens in relatively dilute chromate/chloride electrolyte for 1 h, the predominant chromium state varied with thickness of the film present originally on the substrate. Specimens supporting air-formed films, developed on the electropolished aluminum surface, showed Cr III. For an anodic film, of thickness 6 nm, both Cr III and Cr VI species were observed, whereas with a 36 nm anodic film, Cr VI was the predominant state. The results are discussed in terms of a model where aluminum and its supporting film contains flaws of population density dependent on film thickness. DOE

N87-18657# Northwestern Univ., Evanston, Ill.
USE OF ANOMALOUS SMALL ANGLE X-RAY SCATTERING TO INVESTIGATE MICROSTRUCTURAL FEATURES IN COMPLEX ALLOYS Technical Progress Report, 1 Dec. 1985 - 1 Jul. 1986
J. R. Weertman Jul. 1986 8 p
(Contract DE-FG02-86ER-45229)
(DE87-000193; DOE/ER-45229/T1) Avail: NTIS HC A02/MF A01

The research thrust of this grant has been directed into two areas. The principal effort has been spent in an investigation of the use of anomalous small angle X-ray scattering (ASAXS) to observe changes in the microstructure of a relatively complex alloy produced by high temperature deformation or aging. The second effort involves a study of the high temperature behavior of several ferritic stainless steels. In particular, we are examining the influence of environment (air vs vacuum) on the high temperature strength of Fe9Cr1Mo modified by the addition of small amounts of V, Nb. DOE

N87-18658# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.
ENVIRONMENT-INDUCED EMBRITTLEMENT: EFFECTS OF IMPURITY SEGREGATION AND STATE OF STRESS Final Report, 1 Jul. 1981 - 30 Nov. 1985
L. A. Heldt, M. B. Hintz, and D. A. Koss 1986 6 p
(Contract DE-AC02-81ER-10941)
(DE87-000635; DOE/ER-10941/4) Avail: NTIS HC A02/MF A01

Studied were: embrittlement of Monel 400 by hydrogen and liquid metals, intergranular sulfur in nickel, stress corrosion in Cu-Zn alloys, and hydrogen embrittlement of Zircaloy 2, Ni, and carbon steels. DOE

N87-18659# Los Alamos National Lab., N. Mex.
COUPLE EFFECT BETWEEN CREEP AND PLASTICITY OF TYPE 316 STAINLESS STEEL AT ELEVATED TEMPERATURE
M. Kawai (Nagoya Univ., Japan) and Y. Ohashi (Aichi Inst. of Tech., Toyota, Japan) 1987 8 p Presented at the 2nd International Conference on Constitutive Laws for Engineering Materials, Tucson, Ariz., 5 Jan. 1987
(Contract W-7405-eng-36)
(DE86-012375; LA-UR-86-2003; CONF-870103-3) Avail: NTIS HC A02/MF A01

Interaction between creep and plastic strains is discussed for metallic materials at elevated temperature. The applicability of representative unified constitutive equations to combined creep and plastic deformations is first estimated qualitatively. Then, some actual creep-plasticity interaction of type 316 stainless steel is shown in comparison with predicted results. DOE

N87-18660# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
ADVANCED ALUMINUM ALLOY PLATE MATERIALS FOR DAMAGE TOLERANT AIRCRAFT STRUCTURES
W. G. J. tHart, H. J. Kolkman, L. Schra, and R. J. H. Wanhill Nov. 1986 10 p Presented at the European Materials Research Society on Advanced Materials, R and D for Transport, Strasbourg, France, 26-28 Nov. 1985 Sponsored by the Netherlands Agency for Aerospace Programs
(NLR-MP-85078-U; ETN-87-99294) Avail: NTIS HC A02/MF A01

Engineering properties of the aluminum plate alloy 2324-T39 and the conventional alloy 2024-T351 are compared. Results for the aluminum-lithium alloy DTD XXXA-T651 (Aluminum Association designation 8090) are also included. The strengths of 2324-T39 and DTD XXXA-T651 are comparable and significantly higher than that of 2024-T351; 2324-T39 also has greater fracture toughness. The constant amplitude fatigue crack growth resistance of DTD XXXA-T651 is significantly better than that of the other alloys. Fatigue thresholds are fairly similar. Under flight simulation loading 2324-T39 is inferior to 2024-T351, as is DTD XXXA-T651 for 2 mm thick material. In the absence of significant improvements as compared to 2024-T351, the results imply that replacement of 2024-T351 by 2324-T39, DTD XXXA-T651 (or more lightly tempered version) in fatigue critical areas is not a straightforward proposition. ESA

N87-18661# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
SHORT STRESS CORROSION CRACKS IN ALUMINUM ALLOY COMPONENTS
R. J. H. Wanhill 16 Jan. 1986 19 p Submitted for publication
(NLR-MP-86001-U; ETN-87-99300) Avail: NTIS HC A02/MF A01

Stress corrosion cracking in high strength aluminum alloy aerospace components is discussed, particularly problems in older aircraft and the feasibility of continued service for components containing short cracks. Use of more modern alloys and heat-treatment conditions that have high resistance to stress

corrosion is the most effective for new components. However, for susceptible components already in service this implies reheat-treatment or replacement. Both alternatives may have serious disadvantages in addition to the anticipated costs. Reheat-treatment includes the risk of unacceptable distortion and hence replacement, and timely replacement can be greatly hindered by long delivery periods. ESA

N87-18662# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
FATIGUE IN AIRCRAFT CORROSION TESTING: THE FIRST 10 YEARS
R. J. H. Wanhill and J. J. deLuccia 21 Jan. 1986 18 p Presented at the AGARD Structures and Materials Panel at the 62nd SPM Meeting, Oslo, Norway, Apr. 1986
(NLR-MP-86009-U; ETN-87-99302) Avail: NTIS HC A02/MF A01

The AGARD-coordinated Fatigue in Aircraft Corrosion Testing (FACT) program is reviewed. Objectives include assessment of the effectiveness of state-of-the-art protection schemes for aluminum alloys with respect to corrosion fatigue and corrosion + fatigue; stimulation of the development of protection products, procedures, and techniques; bringing together researchers on both sides of the Atlantic in a common testing effort that would result in a better understanding of the corrosion fatigue phenomenon and the means of mitigating it for aerospace alloys; and enabling participating laboratories to add to their fatigue testing capabilities by using a controlled atmospheric corrosion environment. ESA

N87-18663# Amerind Publishing Co. Pvt. Ltd., New Delhi (India).
INTERDIFFUSION IN ALLOYS
I. B. Borovskii, K. P. Gurov, ed., I. D. Marchukova, and Yu. E. Ugaste 1986 376 p Transl. into ENGLISH of the book "Protsessy Vzaimnoi Diffuzii v Splavakh" Moscow, USSR, Nauka, 1973
(PB86-245495; TT-80-52012) Avail: NTIS HC A17/MF A01 CSCL 11F

Interdiffusion occurs when two different metals are in contact with each other. This process forms the physical basis for some of the methods of thermal treatment of alloys. The present book is devoted to the study of this process alone. Contemporary theories of interdiffusion in binary and multicomponent systems have been described. Features of diffusion in multiphase systems have been examined. Experimental data on interdiffusion in binary systems has been classified and analyzed in detail. The latest methods of measurement and calculation of different parameters characterizing the interdiffusion process have also been described. GRA

N87-18664# Amerind Publishing Co. Pvt. Ltd., New Delhi (India).
THERMOCHEMICAL TREATMENT OF METALS AND ALLOYS: ABSTRACTS OF REPORTS PRESENTED AT THE SECOND ALL-UNION SCIENTIFIC CONFERENCE ON THERMOCHEMICAL TREATMENT OF METALS AND ALLOYS
L. S. Lyakhovich, ed. 1985 308 p Transl. into ENGLISH of the book "Khimiko-Termicheskaya Obrabotka Metallov i Splavov" Minsk, USSR, 1974 Conference held in Minsk, USSR, 22-23 May 1974
(PB86-245487; TT-79-52014) Avail: NTIS HC A14/MF A01 CSCL 11F

The papers presented at the Second All-Union Scientific Conference on Thermochemical Treatment of Metals and Alloys are discussed. Problems pertaining to the theory of formation of diffusion coatings, new techniques for their application and the subsequent development of industrial methods of hardening are discussed. Results of investigations on the formation and properties of diffusion coatings are explained. GRA

N87-18665# United Nations Industrial Development Organization, Vienna (Austria).
ECONOMIC USE OF ALUMINIUM: DEVELOPMENT AND TRANSFER OF TECHNOLOGY SERIES NO. 21
1985 75 p
(PB86-239456; UNIDO-ID/324) Avail: NTIS HC A04/MF A01 CSCL 11F

The report on the economic use of aluminum covers: (1) world use of structural materials, trends in world production and world consumption, pricing; (2) use of aluminum in new applications; (3) promoting its use; research and development; product development; (4) aluminum applications in electrical engineering, manufacture of silos, storage tanks and transport containers, food industry, heating equipment; and (5) product development, standardization, handbooks, and regulations. GRA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N87-18666*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ESTER OXIDATION ON AN ALUMINUM SURFACE USING CHEMILUMINESCENCE
William R. Jones, Jr., Michael A. Meador, and Wilfredo Morales Jul. 1986 16 p
(NASA-TP-2611; E-2647; NAS 1.60:2611) Avail: NTIS HC A02/MF A01 CSCL 11B

The oxidation characteristics of a pure ester (trimethyolpropane triheptanoate) were studied by using a chemiluminescence technique. Tests were run in a thin film microoxidation apparatus with an aluminum alloy catalyst. Conditions included a pure oxygen atmosphere and a temperature range of 176 to 206 C. Results indicated that oxidation of the ester (containing .001 M diphenylanthracene as an intensifier) was accompanied by emission of light. The maximum intensity of light emission was a function of the amount of ester, the concentration of intensifier, and the test temperature. The induction period, or the time to reach one-half of maximum intensity was inversely proportional to test temperature. Decreases in light emission at the later stages of a test were caused by depletion of the intensifier. Author

N87-18667*# National Aeronautics and Space Administration, Washington, D.C.
METHOD TO PREPARE OXIDE FILMS
T. Hirota Sep. 1986 11 p Transl. into ENGLISH of Japanese Patent no. 55-167129 (26 Dec. 1980) p 179-181 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88521; NAS 1.15:88521) Avail: NTIS HC A02/MF A01 CSCL 11G

This invention pertains to a method for producing metal oxide films characterized by the fact that the metal elements constituting the main metal alloys contain at least one kind of transition element, and that the metal elements which constitute said metal alloy are thin films of barium and titanium in almost the same mol ratio. Author

N87-18668*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MECHANICAL STRENGTH AND TRIBOLOGICAL BEHAVIOR OF ION-BEAM DEPOSITED BORON NITRIDE FILMS ON NON-METALLIC SUBSTRATES
Kazuhisa Miyoshi, Donald H. Buckley (Case Western Reserve Univ., Cleveland, Ohio), John J. Pouch, Samuel A. Alterovitz, and Harold E. Sliney 1987 24 p Presented at the International Conference on Metallurgical Coatings, San Diego, Calif., 23-27 Mar. 1987; sponsored by American Vacuum Society
(NASA-TM-89818; E-3439; NAS 1.15:89818) Avail: NTIS HC A02/MF A01 CSCL 11B

An investigation was conducted to examine the mechanical strength and tribological properties of boron nitride (BN) films ion-beam deposited on silicon (Si), fused silica (SiO_2), gallium arsenide (GaAs), and indium phosphide (InP) substrates in sliding contact with a diamond pin under a load. The results of the

investigation indicate that BN films on nonmetallic substrates, like metal films on metallic substrates, deform elastically and plastically in the interfacial region when in contact with a diamond pin. However, unlike metal films and substrates, BN films on nonmetallic substrates can fracture when they are critically loaded. Not only does the yield pressure (hardness) of Si and SiO2 substrates increase by a factor of 2 in the presence of a BN film, but the critical load needed to fracture increases as well. The presence of films on the brittle substrates can arrest crack formation. The BN film reduces adhesion and friction in the sliding contact. BN adheres to Si and SiO2 and forms a good quality film, while it adheres poorly to GaAs and InP. The interfacial adhesive strengths were 1 GPa for a BN film on Si and appreciably higher than 1 GPa for a BN film on SiO2. Author

N87-18669*# Boeing Aerospace Co., Seattle, Wash.
PROTECTIVE COATINGS FOR COMPOSITE TUBES IN SPACE APPLICATIONS
Harry W. Dursch and Carl L. Hendricks 1987 12 p Prepared for presentation at the 3rd International SAMPE Symposium, Anaheim, Calif., 6-9 Apr. 1987
(Contract NAS1-16854)
(NASA-CR-178116; NAS 1.26:178116) Avail: NTIS HC A02/MF A01 CSCL 11B

Protective coatings for graphite/epoxy (Gr/Ep) tubular structures for a Manned Space Station truss structure were evaluated. The success of the composite tube truss structure depends on its stability to long-term exposure to the Low Earth Orbit (LEO) environment with particular emphasis placed on atomic oxygen. Concepts for protectively coating Gr/Ep tubes include use of inorganic coated metal foils and electroplating. These coatings were applied to Gr/Ep tubes and then subjected to simulated LEO environmnet to evaluate survivability of coatings and coated tubes. Evaluation included: atomic oxygen resistance, changes in optical properties and adhesion, abrasion resistancem surface preparation required, coating uniformity, and formation of microcracks in the Gr/Ep tubes caused by thermal cycling. Program results demonstrated that both phosphoric and chromic acid anodized Al foil provided excellent adhesion to Gr/Ep tubes and exhibited stable optical properties when subjected to simulated LEO environment. The SiO2/Al coatings speuttered onto Al foils also resulted in an excellent protective coating. Electroplated Ni exhibited unaccepatble adhesion loss to Gr/Ep tubes during atomic oxygen exposure. Author

N87-18670*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HARDNESS OF CaF2 AND BaF2 SOLID LUBRICANTS AT 25 TO 670 DEG C
Daniel L. Deadmore and Harold E. Sliney Mar. 1987 21 p
(NASA-TM-88979; E-3448; NAS 1.15:88979) Avail: NTIS HC A02/MF A01 CSCL 11G

Plastic deformation is a prominent factor in determining the lubricating value of solid lubricants. Little information is available and its direct measurement is difficult so hardness, which is an indirect measure of this property was determined for fluoride solid lubricant compositions. The Vickers hardness of BaF2 and CaF2 single crystals was measured up to 670 C in a vacuum. The orientation of the BaF2 was near the (013) plane and the CaF2 was about 16 degrees from the degrees from the (1'11) plane. The BaF2 has a hardness of 83 kg/sq mm at the 25 C and 9 at the 600 C. The CaF2 is 170 at 25 C and 13 at 670 C. The decrease in hardness in the temperature range of 25 to 100 C is very rapid and amounts to 40% for both materials. Melts of BaF2 and CaF2 were made in a platinum crucible in ambient air with compositions of 50 to 100 wt% BaF2. The Vickers hardness of these polycrystalline binary compositions at 25 C increased with increasing CaF2 reaching a maximum of 150 kn/sq mm near the eutectic. The polycrystalline CaF2 was 14% softer than that of the single crystal surface and BsF2 was 30% harder than the single crystal surface. It is estimated that the brittle to ductile transition temperature for CaF2 and BaF2 is less than 100 C for the conditions present in the hardness tester. Author

N87-18671# Johns Hopkins Univ., Baltimore, Md. Center for Materials Research.
THERMAL AND MATERIAL TRANSPORT AND THE SOLUBILITY OF OXYGEN AND OTHER GASES IN OXIDIZING POLYMERS Final Report
Joseph H. Flynn and David M. Levin Mar. 1987 27 p
(Grant NBS 60-NANB4D0040)
(NBS-GCR-87-524) Avail: NTIS HC A03/MF A01

A novel but simple heat flow technique was developed for measuring the thermal conductivity of polymeric and other sheet materials on the differential scanning calorimeter (DSC). Values in the range of 1 to 2 x 10(-4) cal cm/(s K sq cm) were obtained for poly(methylmethacrylate) (46 to 136 C) and poly (tetrafluorethylene) (160 to 175 C). Calibration may be required for quantitative measurement as these results are uniformly lower than those obtained from literature. The solubility and diffusion of nitrogen and oxygen in poly(methylmethacrylate) were determined gravimetrically over the temperature range 40 to 121 C. The diffusion of oxygen took place more rapidly than that of nitrogen and yielded an activation energy of 77.6 kj/mol. The solubility of oxygen in PMMA was 0.14 mg/g of PMMA at 25 C. A measurable weight loss occurred for the oxygen-treated specimens at temperatures above the glass transition temperature of 105 C. Author

N87-18672# Durham Univ. (England). Dept. of Chemistry.
SYNTHESIS OF NEW STEREOREGULAR FLUOROPOLYMERS Final Technical Report
W. J. Feast Aug. 1986 72 p
(Contract DAJA45-83-C-0036)
(AD-A174018) Avail: NTIS HC A04/MF A01 CSCL 07/3

Four papers are summarized, the first presents an overview and survey of the work carried out. In the initial stages of the work a broadly based survey of metathesis polymerization of fluorinated monomers was conducted; more detailed studies of particular monomer types were conducted. All the monomers investigated are reviewed along with other systems examined in related projects. A detailed study of the polymerization of 2,3-bis (trifluoromethyl) bicyclo(2.2.1)hepta-2.5-diene, again relevant results from related projects are included in the second paper. The third paper concerns a detailed study of the polymerization of 5-trifluoromethylbicyclo(2.2.1)hept-2-ene, and is exclusively the work of this project. The fourth paper concerns 2-trifluoromethylbicyclo(2.2.1)hepta-2,5-diene as monomer. GRA

N87-18673# Duke Univ., Durham, N. C. Dept. of Chemistry.
NEMATOGENIC AROMATIC BLOCK COPOLYMERS OF RIGID AND FLEXIBLE UNITS. 2: PHASE EQUILIBRIA
W. R. Krigbaum, Z. Shufan, Jack Preston, A. Ciferri, and G. Conio 6 Nov. 1986 3 p
(Contract N00014-84-K-0496)
(AD-A174735; TR-2-Pt-2) Avail: NTIS HC A02/MF A01 CSCL 07/4

Chemically dissimilar polymers are generally incompatible, and this incompatibility is even more marked for a coiling polymer in the nematic phase of a more rigid polymer. Phase diagrams were determined for the aromatic block copolymers of rigid and flexible units described in a previous paper. Flexible blocks enter the nematic phase formed by the rigid units. The flexible homopolymer also enters the nematic phase, but this seems to be due to the formation of an adduct involving the flexible and rigid polymers when both are polymerized simultaneously. GRA

N87-18674# Sandia National Labs., Albuquerque, N. Mex. Aerodynamics Dept.
KINETICS FOR THE DEGRADATION OF NYLON AND KEVLAR PARACHUTE MATERIALS
I. Auerbach 1986 10 p Presented at the 9th Aerodynamic Decelerator and Balloon Technology Conference (AIAA), Albuquerque, N. Mex., 7 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE86-014290; SAND-86-0853C; CONF-861050-3) Avail: NTIS HC A02/MF A01

The degradation of nylon 66 and Kevlar 29 yarns at elevated

temperatures and over a broad range of humidities was studied and a rate relationship developed which models the degradation and permits computation of rate constants. The degradation rates are slow initially due to the presence of an inhibitor but increase rapidly as the inhibitor is depleted. The effect of relative humidity (RH) can be very large especially at values in the 100% range. An exponential relationship exists for nylon between the rate constant and RH. Kinetic parameters were evaluated and the rate constants at 25 C calculated. These values showed that the tensile strength of nylon 66 will remain at a safe level over a 25-year period if the humidity is maintained at the 10% range or less. Kevlar 29 is more resistant and can tolerate humidity levels in the range of 90% or less. Degradation is governed by thermal-oxidative and moisture induced mechanisms. At the very high humidities the moisture induced degradation predominates. A relationship is developed which predicts the degradation rate over a very broad range of temperatures and humidities. DOE

N87-18675# Allied Bendix Corp., Kansas City, Mo.
PYROLYSIS GAS CHROMATOGRAPHY/MASS SPECTROMETRIC ANALYSIS OF POLYMERS USING CAPILLARY HIGH RESOLUTION METHODS Final Report
M. B. Pennington Jul. 1986 16 p
(Contract DE-AC04-76DP-00613)
(DE86-014653; BDX-613-3558) Avail: NTIS HC A02/MF A01

A method for polymeric analysis based on pyrolysis followed by gas chromatography/mass spectrometry has been developed using high resolution, capillary gas chromatography directly interfaced to a double-focussing mass spectrometer. Introduction of samples using the pyrolysis carrier gas of choice through the split injection port followed by sub-ambient focussing of the pyrolysis products gave reproducible chromatograms. DOE

N87-18676# Centre Technique des Industries Mecaniques, St. Etienne (France).
TECHNOLOGICAL STUDY OF CASES ASSEMBLED BY BONDING Final Report [ETUDE TECHNOLOGIQUE DE CAS EN COLLAGE]
J. Zirah, G. Chaumarat, and M. Chaussin 1 Sep. 1985 165 p In FRENCH
(CETIM-100290; ETN-87-99156) Avail: NTIS HC A08/MF A01

The possibility of replacing elaborately machined structures by structures composed of simpler elements bonded together was studied. A variety of bonded structures were assembled and their shear characteristics determined. The results enable the structural parameters, such as surface preparation, choice of adhesive, and couplings to be optimized. A mathematical model based on the statistical analysis of the results and taking the different parameters into account is proposed. ESA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N87-18677# Atomic Weapons Research Establishment, Aldermaston (England).
THE RESPONSE OF BARE EXPLOSIVES TO ATTACK BY CYLINDRICAL AND SPHERICAL PROJECTILES
H. R. James Aug. 1986 63 p
(ARWE-O-6/86; BR100647; ETN-87-99117) Avail: NTIS HC A04/MF A01

The empirical criterion developed by Walker and Wasley for predicting the response of bare, heterogeneous explosives to flying plate impacts which postulates that there is a critical energy per unit area associated with a given explosive which, if exceeded by the impact shock, causes detonation, was modified to extend its area of application to cover a wider range of projectile geometries. The modified criterion is tested against published experimental data for PBX9404, tetryl, Composition B, and TNT. It is shown that using the modified criterion, critical energy values obtained from rod and sphere impacts are in good agreement with those obtained from flying plate tests. If the critical energy for an explosive is known, the response of that explosive to rod, sphere, or plate impacts can be predicted using the modified criterion. ESA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N87-18678*# Alabama Univ., Huntsville. Dept. of Physics.
SPACE PROCESSING WORKSHOP Final Report
Nov. 1984 12 p Workshop held in Huntsville, Ala., 11-12 Jul. 1979
(Contract NAS8-33542)
(NASA-CR-171286; NAS 1.26:171286) Avail: NTIS HC A02/MF A01 CSCL 22A

Gravitational effects on electrodeposition were studied on the KC-135 aircraft parabolic flight paths. An experiment to investigate the effect of the hyperthermal atomic oxygen atmosphere on sensitive surfaces was flown on Space Shuttle Flight STS-18. A participant list and schedule for the Fluids Experiment System (FES) Workshop are given. B.G.

N87-18679*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE ULTRA-VACUUM FACILITY AND METHOD OF OPERATION Patent Application
Robert J. Naumann, inventor (to NASA) Filed 26 Sep. 1986 17 p
(NASA-Case-MFS-28139-1; NAS 1.71:MFS-28139-1;
US-Patent-Appl-SN-911851) Avail: NTIS HC A02/MF A01 CSCL 22A

A wake shield facility providing an ultrahigh vacuum level for space processing is described. The facility is in the shape of a truncated, hollow hemispherical section, one side of the shield convex and the other concave. The shield surface is preferably made of material that has low out-gassing characteristics such as stainless steel. A material sample supporting fixture in the form of a carousel is disposed on the convex side of the shield at its apex. Movable arms, also on the convex side, are connected by the shield in proximity to the carousel, the arms supporting processing fixtures, and providing for movement of the fixtures to predetermined locations required for producing interations with material samples. For MBE processes a vapor jet projects a stream of vaporized material onto a sample surface. The fixtures are oriented to face the surface of the sample being processed when in their extended position, and when not in use they are retractable to a storage position. The concave side of the shield has a support structure including metal struts connected to the shield, extending radially inward. The struts are joined to an end plate disposed parallel to the outer edge of the shield. This system eliminates outgassing contamination. Author

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N87-18680*# California Univ., Los Angeles. Dept. of Chemical Engineering.
THERMAL COMPONENTS FOR 1.8 K SPACE CRYOGENICS
W. E. W. Chen, W. A. Hepler, and T. H. K. Frederking Oct. 1986 40 p
(Grant NAG2-412)
(NASA-CR-180205; NAS 1.26:180205; UCLA-ENG-8640) Avail:

NTIS HC A03/MF A01 CSCL 13I

Work of the summer 1986 is summarized in three areas. First, conceptual design of a laboratory system for heat exchanger evaluation in conjunction with the operation of a thermally activated fountain effect pump (FEP) is presented. Second, Knudsen effect evaluation of fine porous media useful for the pressurization plug which forms the main component of the FEP is described. Third, proof-of-principle test of the lab system selected on the basis of the evaluation is summarized. Author

N87-18681# Allied Bendix Aerospace, Kansas City, Mo.
MEASUREMENT CAPABILITIES OF THE BKC METROLOGY ORGANIZATION
L. M. Barnes Aug. 1986 80 p
(Contract DE-AC04-76DP-00613)
(DE86-015992; BDX-613-3024-Rev-2) Avail: NTIS HC A05/MF A01

Purpose of this manual is to communicate to concerned persons the measurement and calibration capabilities of the Metrology Organization of the Allied Corporation, Bendix Kansas City Division (BKC). Included is a listing of the measurement types and ranges available, and the accuracies normally attainable. Also described are currently used standards and measurement devices. This manual is divided into four major sections, each describing a broad general area of measurement: mechanical; environmental, gas, liquid; electrical (dc, ac, RF/microwave); and optical and radiation. DOE

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N87-18682 British Broadcasting Corp., Kingswood (England). Engineering Div.
DEVELOPMENT OF SLIDE FILE (TRADEMARK): A DIGITAL STORE FOR TV STILLS
M. Weston Oct. 1986 23 p
(BBC-RD-1986/10) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Slide File (TM) is designed to take the place of slide scanners in studios as the prime source of broadcast-captions and still pictures. It stores still pictures in electronic digital form and enables them to be selected for transmission by a simple cut or crossfade operation. Such a store provides a convenient means of handling still pictures generated using new electronic techniques as well as handling pictures derived from scanning sides. Slide File has an RGB input and two RGB output (Main and Preview), each fed from a YUV picture store. One or two 8' Winchester Disc Drives store 84 to 344 pictures with an access time of one second. One-quarter-inch Streaming Tape Cartridges provide longer term storage of up to 74 pictures each. The system may be controlled by up to 5 remote control panels. The 6809 control microprocessor may also be used to process the stored pictures to remove impairments commonly found when a picture is grabbed from a moving picture input or decoded from a composite (PAL/NTSC) input. Author

N87-18683 Institut National Polytechnique, Grenoble (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
SPACE-TIME ANALYSIS OF THE ACOUSTIC WAVE SIGNAL RECEIVED BY A LONG ANTENNA IN THE CASE OF A MULTI-FREQUENCY EXCITATION [ANALYSE SPATIO-TEMPORELLE DE L'ONDE RECUE SUR UNE ANTENNE LONGUE EN A.S.M. DANS LE CAS D'UNE EXCITATION MULTIFREQUENCE]
S. Bourennane 1986 58 p In FRENCH
(CEPHAG-45/86; ETN-87-99041) Avail: NTIS HC A04

A seismic flute type 2400 m long antenna was used to receive the signal transmitted underwater at distances up to 2000 km. The two ships maintained a 45 deg attitude. The signal was received at 4 different frequencies and the detectors along the antenna were spaced at 25m. The analysis of the phases of the Fourier transform at a given frequency gives information about the wave surface received by the antenna. A spatial filter treatment allows the separation of the effects of antenna deformation and the influence of the propagation media. ESA

N87-18684 Institut National Polytechnique, Grenoble (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
A WAVE RECEPTION MODEL FOR SOURCE CHARACTERIZATION
P. Comon and J. L. Lacoume 21 Jul. 1986 20 p Sponsored by the Direction of the French Naval Constructions
(CEPHAG-47/86; ETN-87-99042) Avail: NTIS HC A02

A reception model for waves propagated through a deterministic medium was designed. The concept of propagation modes is introduced, and the mode properties are emphasized. This very general approach leads to an observation model which is shown to be useful in many situations occurring in physics. The unknown parameters are deterministic and random. An optimization procedure allowing the estimation of a remote source is proposed. In the case of a totally polarized source, the estimate turns out to be very simple. ESA

N87-18685 British Broadcasting Corp., Kingswood (England). Engineering Div.
REVIEW AND ANALYSIS OF VHF/UHF FIELD STRENGTH MEASUREMENTS: MEASUREMENTS AT VHF OVER PATH LENGTHS GREATER THAN 100 KM
R. S. Sandell, C. P. Bell, and D. W. Taplin Dec. 1986 24 p
(BBC-RD-1986/17; RA-220) Avail: BBC, Kingsworth Warren, Tadworth, Surrey, England

In 1983 CCIR/IWP 5/5 put forward a number of proposals for improvements to the field strength prediction methods of CCIR Recommendation 370 and associated Report 239, as used for international planning negotiations in the VHF and UHF Broadcast Bands. Described are the results of studies carried out by the BBC, in conjunction with other propagation investigations, to assess the validity of those proposals of IWP 5/5 which relate to propagation over path lengths in excess of about 100 km in the VHF Bands. It is concluded that these proposals can be supported with only one exception, relating to an addition of 7 dB to beyond-horizon oversea curves. Subsequently, the VHF proposals (excepting the one relating to the 7 dB correction) have been endorsed by CCIR Study Group 5 and adopted by the Plenar Meeting in 1986 for inclusion as modifications to Recommendation 370. Even so, limitations in the exsiting methods are identified and further work is proposed. Author

N87-18686 British Broadcasting Corp., Kingswood (England). Engineering Div.
LF AND MF SKY-WAVE PROPAGATION: A COMPARISON OF MEASUREMENTS MADE AT SUNSET AND SUNRISE
P. Knight and W. F. Williams Dec. 1986 15 p
(BBC-RD-1986/18; RA-232) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

The strength of LF and MF sky-wave signals is greatest at night and weakest during the day. The increase in field strength which occurs at sunset has been extensively studied but less is known about the decrease which occurs at sunrise. This Report describes a series of measurements made by members of the European Broadcasting Union (EBU) which covers both the sunrise and sunset periods. The results show that during the sunset period the new measurements agree closely with the existing CCIR curve but that the sunrise measurements indicate that the existing CCIR curve is inaccurate, and a modified curve for MF use is proposed. The LF measurements show significant seasonal variations and it is suggested that a set of seasonal curves

for LF, for use in temperate regions, should be considered in the future. Author

N87-18687 British Broadcasting Corp., Kingswood (England). Engineering Div.
SATELLITE BROADCASTING: DIFFERENTIAL DEMODULATION OF A 2-4 PSK SIGNAL USING A THREE-PORT SAW DELAY LINE
P. Shelswell and J. P. Willson Dec. 1986 12 p
(BBC-RD-1986/12; RA-223) Avail: BBC, Kingsworth Warren, Tadworth, Surrey, England

Described is a SAW (Surface Acoustic Wave) device which can be used to differentially demodulate the 2 to 4 PSK (Phase Shift Keying) data signal in a C-MAC receiver. It shows that the system can be optimized so that the performance is good even in the presence of typical instrumental inaccuracies caused by manufacturing tolerances and thermal expansion. Author

N87-18688*# National Aeronautics and Space Administration, Washington, D.C.
DESIGN METHOD FOR FOUR-REFLECTOR TYPE BEAM WAVEGUIDE SYSTEMS
S. Betsudan, T. Katagi, and S. Urasaki Sep. 1986 25 p Transl. into ENGLISH from Japanese Electronics and Communications Society Journal (Japan), v. J67-B, no. 6, Jun. 1984 p 622-629 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88519; NAS 1.15:88519) Avail: NTIS HC A02/MF A01 CSCL 20N

Discussed is a method for the design of four reflector type beam waveguide feed systems, comprised of a conical horn and 4 focused reflectors, which are used widely as the primary reflector systems for communications satellite Earth station antennas. The design parameters for these systems are clarified, the relations between each parameter are brought out based on the beam mode development, and the independent design parameters are specified. The characteristics of these systems, namely spillover loss, crosspolarization components, and frequency characteristics, and their relation to the design parameters, are also shown. It is also indicated that design parameters which decide the dimensions of the conical horn or the shape of the focused reflectors can be unerringly established once the design standard for the system has been selected as either: (1) minimizing the crosspolarization component by keeping the spillover loss to within acceptable limits, or (2) minimizing the spillover loss by maintaining the crossover components below an acceptable level and the independent design parameters, such as the respective sizes of the focused reflectors and the distances between the focussed reflectors, etc., have been established according to mechanical restrictions. A sample design is also shown. In addition to being able to clarify the effects of each of the design parameters on the system and improving insight into these systems, the efficiency of these systems will also be increased with this design method. Author

N87-18689*# National Aeronautics and Space Administration, Washington, D.C.
PROPERTY OF RADIALLY QUADRATIC REFLECTOR SYSTEMS
M. Mizusawa and T. Katagi Sep. 1986 9 p Transl. into ENGLISH from Japanese Electronics and Communications Society Journal (Japan), v. 53, no. 1, Nov. 1970 p 707-708 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88522; NAS 1.15:88522) Avail: NTIS HC A02/MF A01 CSCL 20N

This report shows that when considered in terms of optical geometry, radially parabolic and radially hyperbolic mirrors used as mirrors for Cassegrain and parabolic antennas possess values similar to common conical horn reflector antennas. Author

N87-18690*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ERROR CONTROL TECHNIQUES FOR SATELLITE AND SPACE COMMUNICATIONS Semiannual Status Report, 1 Jun. 1985 - 31 May 1987
Daniel J. Costello, Jr. Feb. 1987 81 p
(Grant NAG5-557)
(NASA-CR-180117; NAS 1.26:180117) Avail: NTIS HC A05/MF A01 CSCL 17B

During the period June 1, 1986 through November 30, 1986, progress was made in the following areas: undetected error probability and throughput analysis of a concatenated coding scheme; capacity and cutoff rate analysis of concatenated codes; concatenated codes using bandwidth efficient trellis inner codes; bounds on the minimum free Euclidean distance of bandwidth efficient trellis codes; and construction of multidimensional bandwidth efficient trellis codes for use as inner codes in a concatenated coding system. B.G.

N87-18691*# National Aeronautics and Space Administration. Pasadena Office, Calif.
TRELLIS CODED MODULATION FOR TRANSMISSION OVER FADING MOBILE-SATELLITE CHANNEL Patent Application
Marvin K. Simon, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena) and Dariush Divsalar, inventor (to NASA) Filed 9 Dec. 1986 52 p
(Contract NAS7-918)
(NASA-Case-NPO-16904-1-CU; NAS 1.71:NPO-16904-1-CU; US-Patent-Appl-SN-929876) Avail: NTIS HC A04/MF A01 CSCL 17B

The combination of trellis coding and Multiple Pulse Shift Keying (MPSK) signaling with asymmetry (nonuniform spacing) to the signal set is disclosed with regard to its suitability for a fading mobile satellite communication channel. For MPSK signaling, introducing nonuniformity in the phase spacing between signal points provides an improvement in performance over that achievable with trellis coded symmetric MPSK signaling, all this without increasing the average or peak power, or changing the bandwidth constraints imposed on the system. Block interleaving may be used to reduce error and pilot tone(s) may be used for improving the error correction performance of the trellis decoder in the presence of channel fading. NASA

N87-18692*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
METHOD AND APPARATUS FOR MEASURING FREQUENCY AND PHASE DIFFERENCE Patent Application
Paul Shores, inventor (to NASA), Christopher Lichtenberg, inventor (to NASA), Herbert S. Kobayashi, inventor (to NASA), and Allen R. Cunningham, inventor (to NASA) Filed 29 Oct. 1986 31 p
(NASA-Case-MSC-20865-1; US-Patent-Appl-SN-924472; NAS 1.71:MSC-20865-1) Avail: NTIS HC A03/MF A01 CSCL 20N

The present invention is a system for deriving direct digital indications of frequency and phase difference between two incoming pulse trains adaptable for collision avoidance systems or the like. A pair of radar beams are directed toward a target and corresponding beams returning therefrom are detected. A digital difference circuit forms a pulse train from the Doppler shift frequencies of each beam pair having a repetition rate functionally related to the difference in magnitude of the shift frequencies. Pulses from the pulse train are counted as a function of time. Visual indications thereof on display are correlative to target position relative to beams. NASA

N87-18693*# Axiomatix, Los Angeles, Calif.
SHUTTLE COMMUNICATION AND TRACKING SYSTEMS SIGNAL DESIGN AND INTERFACE COMPATIBILITY ANALYSIS Final Report
16 Jun. 1986 300 p
(Contract NAS9-17384)
(NASA-CR-171974; NAS 1.26:171974; Axiomatix-R8606-3) Avail: NTIS HC A13/MF A01 CSCL 17B

Various options for the Dedicated Payload Communication Link (DPCL) were evaluated. Specific subjects addressed include: payload to DPCL power transfer in the proximity of the payload, DPCL antenna pointing considerations, and DPCL transceiver

implementations which can be mounted on the deployed antenna boom. Additional analysis of the Space Telescope performance was conducted. The feasibility of using the Global Positioning System (GPS) for attitude determination and control for large spacecraft was examined. The objective of the Shuttle Orbiter Radar Test and Evaluation (SORTE) program was to quantify the Ku-band radar tracking accuracy using White Sands Missile Range (WSMR) radar and optical tracking equipment, with helicopter and balloon targets. B.G.

N87-18694*# Illinois Univ., Urbana-Champaign. Electro-Optic Systems Lab.

COMPARISON OF DIRECT AND HETERODYNE DETECTION OPTICAL INTERSATELLITE COMMUNICATION LINKS

C. C. Chen and C. S. Gardner Mar. 1987 227 p
(Grant NsG-5049)
(NASA-CR-180210; NAS 1.26:180210; EOSL-87-002; UIUL-ENG-87-2548) Avail: NTIS HC A11/MF A01 CSCL 17B

The performance of direct and heterodyne detection optical intersatellite communication links are evaluated and compared. It is shown that the performance of optical links is very sensitive to the pointing and tracking errors at the transmitter and receiver. In the presence of random pointing and tracking errors, optimal antenna gains exist that will minimize the required transmitter power. In addition to limiting the antenna gains, random pointing and tracking errors also impose a power penalty in the link budget. This power penalty is between 1.6 to 3 dB for a direct detection QPPM link, and 3 to 5 dB for a heterodyne QFSK system. For the heterodyne systems, the carrier phase noise presents another major factor of performance degradation that must be considered. In contrast, the loss due to synchronization error is small. The link budgets for direct and heterodyne detection systems are evaluated. It is shown that, for systems with large pointing and tracking errors, the link budget is dominated by the spatial tracking error, and the direct detection system shows a superior performance because it is less sensitive to the spatial tracking error. On the other hand, for systems with small pointing and tracking jitters, the antenna gains are in general limited by the launch cost, and suboptimal antenna gains are often used in practice. In which case, the heterodyne system has a slightly higher power margin because of higher receiver sensitivity. Author

N87-18695*# TRW Electronic Systems Group, Redondo Beach, Calif.

ADVANCED SPACE COMMUNICATIONS ARCHITECTURE STUDY. VOLUME 2: TECHNICAL REPORT Contractor Report, Jan. 1986 - Mar. 1987

Michael Horstein and Peter J. Hadinger Mar. 1987 193 p
(Contract NAS3-24743)
(NASA-CR-179592; NAS 1.26:179592) Avail: NTIS HC A09/MF A01 CSCL 17B

The technical feasibility and economic viability of satellite system architectures that are suitable for customer premise service (CPS) communications are investigated. System evaluation is performed at 30/20 GHz (Ka-band); however, the system architectures examined are equally applicable to 14/11 GHz (Ku-band). Emphasis is placed on systems that permit low-cost user terminals. Frequency division multiple access (FDMA) is used on the uplink, with typically 10,000 simultaneous accesses per satellite, each of 64 kbps. Bulk demodulators onboard the satellite, in combination with a baseband multiplexer, convert the many narrowband uplink signals into a small number of wideband data streams for downlink transmission. Single-hop network interconnectivity is accomplished via downlink scanning beams. Each satellite is estimated to weigh 5600 lb and consume 6850W of power; the corresponding payload totals are 1000 lb and 5000 W. Nonrecurring satellite cost is estimated at $110 million, with the first-unit cost at $113 million. In large quantities, the user terminal cost estimate is $25,000. For an assumed traffic profile, the required system revenue has been computed as a function of the internal rate of return (IRR) on invested capital. The equivalent user charge per-minute of 64-kbps channel service has also been determined. Author

N87-18696*# TRW Electronic Systems Group, Redondo Beach, Calif.

ADVANCED SPACE COMMUNICATIONS ARCHITECTURE STUDY. VOLUME 1: EXECUTIVE SUMMARY Contractor Report, Jan. 1986 - Mar. 1987

Michael Horstein and Peter J. Hadinger Mar. 1987 14 p
(Contract NAS3-24743)
(NASA-CR-179591; NAS 1.26:179591) Avail: NTIS HC A02/MF A01 CSCL 17B

The technical feasibility and economic viability of satellite system architectures that are suitable for Customer Premise Service (CPS) communications is investigated. System evaluation is performed at 30/20 GHz (Ka-band); however, the system architectures examined are equally applicable to 14/11 GHz (Ku-band). Emphasis is placed on system that permit low cost user terminals. Frequency Division Multiple Access (FDMA) is used on the uplink, with typically 10,000 simultaneous accesses per satellite, each of 64 kbps. Bulk demodulators onboard the satellite, in combination with a baseband multiplexer, convert the many narrowband uplink signals into a small number of wideband data streams for downlink transmission. Single hop network interconnectivity is accomplished through use of downlink scanning beams. Each satellite is estimated to weigh 5600 lb and consume 6850W of power; the corresponding payload totals are 1000 lb and 5000W. Nonrecurring satellite cost is estimated at $110 million, with the first unit cost at $113 million. In large quantities, the user terminal cost estimate is $25,000. Author

N87-18697*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SHUTTLE IMAGING RADAR-C SCIENCE PLAN

1 Sep. 1986 180 p Original contains color illustrations
(Contract NAS7-918)
(NASA-CR-180241; JPL-PUB-86-29; NAS 1.26:180241) Avail: NTIS HC A09/MF A01 CSCL 17I

The Shuttle Imaging Radar-C (SIR-C) mission will yield new and advanced scientific studies of the Earth. SIR-C will be the first instrument to simultaneously acquire images at L-band and C-band with HH, VV, HV, or VH polarizations, as well as images of the phase difference between HH and VV polarizations. These data will be digitally encoded and recorded using onboard high-density digital tape recorders and will later be digitally processed into images using the JPL Advanced Digital SAR Processor. SIR-C geologic studies include cold-region geomorphology, fluvial geomorphology, rock weathering and erosional processes, tectonics and geologic boundaries, geobotany, and radar stereogrammetry. Hydrology investigations cover arid, humid, wetland, snow-covered, and high-latitude regions. Additionally, SIR-C will provide the data to identify and map vegetation types, interpret landscape patterns and processes, assess the biophysical properties of plant canopies, and determine the degree of radar penetration of plant canopies. In oceanography, SIR-C will provide the information necessary to: forecast ocean directional wave spectra; better understand internal wave-current interactions; study the relationship of ocean-bottom features to surface expressions and the correlation of wind signatures to radar backscatter; and detect current-system boundaries, oceanic fronts, and mesoscale eddies. And, as the first spaceborne SAR with multi-frequency, multipolarization imaging capabilities, whole new areas of glaciology will be opened for study when SIR-C is flown in a polar orbit. Author

N87-18698# Danish Space Research Inst., Lyngby.

FIRST VIKING RESULTS: HIGH FREQUENCY WAVES

A. Bahnsen, M. Jespersen, E. Ungstrup, R. Pottelette (Centre National d'Etudes des Telecommunications, Saint Maur des Fosses, France), M. Malingre, P. M. E. Decreau (Centre National de la Recherche Scientifique, Orleans, France), M. Hamelin, H. deFeraudy (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France), S. Perraut, and B. M. Pedersen (Observatoire de Paris-Meudon, France) 1986 20 p
(DRI-5-86; ISSN-0109-6605) Avail: NTIS HC A02/MF A01

The high frequency wave experiment onboard the Viking

satellite measures electric and magnetic fields and the plasma frequency in the range 4 to 700 kHz. The magnetic field sensor is a loop antenna with its axis parallel to the satellite spin axis, the electric field sensor is one of the radial boom dipoles also used for DC and low frequencies. The sensitivity is 10 to the -14 power Tesla/sq rt. Hz for magnetic fields, 5 X 10 to the -8 power V/m sq rt Hz for electric fields. The plasma frequency is measured by wave activation and by impedance measurements of the plasma. The frequency range available corresponds to plasam densities from 1 to 3000 per cm. Data from the initial operating period show frequent wave activity. In approximately half of the passes hiss and auroral kilometric radiation is observed in the auroral region in the evening side and sometimes also in the morning side. The radiation shows strong variations within a few seconds in spectral shape, and is often clearly limited by cutoffs in frequency. Very low plasma frequencies are often registered, corresponding to a few electrons per cubic cm at 1 to 2 Earth radii above the polar region. Author

N87-18699# Communications Research Centre, Ottawa (Ontario). Radar and Communications Technology Branch.
STATISTICS OF ATTENUATION BY RAIN OF 13 GHz SIGNALS ON EARTH-SPACE PATHS IN CANADA
R. V. Webber, J. I. Strickland, and J. J. Schlesak Apr. 1986 47 p
(CRC-1400; ISBN-0-662-15109-7) Avail: NTIS HC A03/MF A01

To accommodate the increased number of users of radio signals, communication systems are being designed more and more to operate at microwave frequencies that were hitherto unused. A major difficulty with frequencies above 10 GHz is that they are attenuated by rain. Attenuation statistics and fade rate statistics from six locations, all in Canada, are presented for 13 GHz signals on Earth-space paths. These statistics are based on a total of 15.7 station-years of attenuation measurements with the operating time of the individual stations ranging from 1.68 to 4.91 years. Author

N87-18700*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A Ka-BAND SATELLITE SYSTEM UNDER VARIABLE TRANSMITTED SIGNAL POWER CONDITIONS
Gene Fujikawa and Robert J. Kerczewski 1987 12 p Prepared for presentation at the IEEE MTT-S International Microwave Symposium and Exhibition, Las Vegas, Nev., 9-11 Jun. 1987
(NASA-TM-88984; E-3454; NAS 1.15:88984) Avail: NTIS HC A02/MF A01 CSCL 17B

A laboratory hardware-based satellite communication system simulator has been used to measure the effects of transmitted signal power changes on the performance of a Ka-band system. Such power changes can be used to compensate for signal fade due to rain attenuation. This paper presents and discusses the results of these measurements. Author

N87-18701# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ROBUST COARTICULATORY MODELING FOR CONTINUOUS SPEECH RECOGNITION Technical Report, Jan. 1985 - Sep. 1986
R. Schwartz, Y. L. Chow, M. O. Dunham, O. Kimball, M. Krasner, F. Kubala, J. Makhoul, P. Price, and S. Roucos Oct. 1986 39 p
(Contract N00014-85-C-0279; DARPA Order 4707)
(AD-A174393; BBN-6383) Avail: NTIS HC A03/MF A01 CSCL 05/7

The purpose of this project is to perform research into algorithms for the automatic recognition of individual sounds or phonemes in continuous speech. The algorithms developed should be appropriate for understanding large-vocabulary continuous speech input and are to be made available to the Strategic Computing Program for incorporation in a complete word recognition system. This report describes process to date in developing phonetic models that are appropriate for continuous speech recognition. In continuous speech, the acoustic realization of each phoneme depends heavily on the preceding and following phonemes: a process known as coarticulation. Thus, while there are relatively few phonemes in English (on the order of fifty or so), the number of possible different accoustic realizations is in the thousands. Therefore, to develop high-accuracy recognition algorithms, one may need to develop literally thousands of relatively distance phonetic models to represent the various phonetic context adequately. Developing a large number of models usually necessitates having a large amount of speech to provide reliable estimates of the model parameters. The major contributions of this work are the development of: (1) A simple but powerful formalism for modeling phonemes in context; (2) Robust training methods for the reliable estimation of model parameters by utilizing the available speech training data in a maximally effective way; and (3) Efficient search strategies for phonetic recognition while maintaining high recognition accuracy. GRA

N87-18702# Naval Ocean Systems Center, San Diego, Calif.
OVER-WATER RADIO PROPAGATION IN THE FREQUENCY RANGE FROM 30 MHz - 300 GHz
J. H. Richter Jul. 1986 38 p
(AD-A174714; NOSC/TD-973) Avail: NTIS HC A03/MF A01 CSCL 17/2

The effects of electromagnetic wave propagation along water surfaces are assessed for the entire electromagnetic spectrum from very low frequencies up to those in optical ranges. Normal and abnormal propagation conditions are examined with the aim of optimizing the performance of modern systems in communications, surveillance, and navigation, with special attention devoted to adaptive measures. E.R.

N87-18703# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.
SPECIAL COURSE ON INTERACTION OF PROPAGATION AND DIGITAL TRANSMISSION TECHNIQUES
Loughton, England Oct. 1986 308 p Special course held in Jevnaker, Norway, 13-14 Oct. 1986, in Copenhagen, Denmark, 16-17 Oct. 1986, and in Lisbon, Portugal, 20-21 Oct. 1986
(AD-A175698; AGARD-R-744; ISBN-92-835-1539-0) Avail: NTIS HC A14/MF A01

This Special Course has three main objectives: (1) To provide an opportunity for engineers and scientists to learn more of propagation mechanisms and communications system design in frequency bands other than those with which they may be closely associated, thus enabling a cross-fertilization of ideas to take place; (2) To attempt to identify, for the various classes of systems, the propagation measurements/data still required to enable digital communication system design to be made more precise and effective; and (3) To identify trends in the requirements and design techniques for future digital communication systems. This Special Course, sponsored by the Electromagnetic Wave Propagation Panel of AGARD, has been implemented by the Consultant and Exchange Program of AGARD, and was presented at Jevnaker, Norway, 13 to 14 October 1986, at Copenhagen, Denmark, 16 to 17 October 1986 and in Lisbon, Portugal, 20 to 21 October 1986. For individual titles, see N87-18704 through N87-18711.

N87-18704# Hull Univ. (England). Dept. of Electronic Engineering.
REVIEW OF MODULATION, CODING AND SPEECH DIGITISATION TECHNIQUES
M. Darnell *In* AGARD and Special Course on Interaction of Propagation and Digital Transmission Techniques Oct. 1986 17 p (For primary document see N87-18703 11-32)
Avail: NTIS HC A14/MF A01

As a basis for the more detailed discussion of specific forms of digital communication system in this special course, this lecture introduces the following topics in general terms: (1) modulation; (2) coding for error control; (3) coding for multiple-access; (4) coding for encryption; and (5) speech digitization. Author

N87-18705# Naval Research Lab., Washington, D. C. Ionospheric Effects Branch.
ELF/VLF/LF PROPAGATION AND SYSTEM DESIGN

Francis J. Kelly *In* AGARD and Special Course on Interaction of Propagation and Digital Transmission Techniques Oct. 1986 110 p (For primary document see N87-18703 11-32)
Avail: NTIS HC A14/MF A01

The effects of propagation conditions in the ELF/VLF/LF frequency band on the design and performance of digital communications systems are described. The communications channel from a ground-based or airborne transmitting antenna throught the Earth-ionosphere waveguide to the receiver is discussed. Questions of coverage, noise, dispersion, time variance and propagation disturbances are summarized. Author

N87-18706# Deutsche Welle, Cologne (West Germany).
HF GROUNDWAVE AND SKYWAVE PROPAGATION
Klaus-Juergen Hortenbach *In* AGARD and Special Course on Interaction of Propagation and Digital Transmission Techniques Oct. 1986 25 p (For primary document see N87-18703 11-32)
Avail: NTIS HC A14/MF A01

The principles of HF ground- and skywave propagation are reviewed with regard to regular conditions as well as anomalous phenomena which may effect the signal characteristics and thus may have an influence on the performance of digital communication systems. Particular consideration is given to the statistics of signal fading as a basis for system design. Author

N87-18707# Hull Univ. (England). Dept. of Electronic Engineering.
HF SYSTEM DESIGN
M. Darnell *In* AGARD and Special Course on Interaction of Propagation and Digital Transmission Techniques Oct. 1986 24 p (For primary document see N87-18703 11-32)
Avail: NTIS HC A14/MF A01

This lecture is intended to complement the companion lecture dealing with the propagation aspects of HF communications. The major topics covered are as follows: (1) the design of point-to-point systems; (2) the design of systems involving mobile terminals; (3) system control and frequency management; and (4) resistance to interception and disruption. The lecture attempts to show how the propagation effects discussed in the previous lecture on HF groundwave and skywave propagation are taken into account in the design of HF communications systems for various purposes. Author

N87-18708# Danish Research Center for Applied Electronics, Hoersholm.
METEOR BURST PROPAGATION AND SYSTEM DESIGN
Jens Ostergaard *In* AGARD and Special Course on Interaction of Propagation and Digital Transmission Techniques Oct. 1986 19 p (For primary document see N87-18703 11-32)
Avail: NTIS HC A14/MF A01

The first truly operational meteor scatter communication system (JANET) was operated in Canada in the mid 1950's at approximately 40 MHz. However the system was severely impaired during a Solar Proton Event, and experimental interest in meteor scatter propagation essentially vanished. SHAPE Technical Center developed and tested a new meteor scatter communication system (COMET) in the mid 1960's in Central Europe and Norway which worked well although it had a fairly low capacity (1 to 4 telegraph channels). The system was tested both at 40 MHz and at 100 MHz to explore the frequency dependent properties of meteor scatter propagation. The advent of satellite communication diverted interest away from meteor scatter propagation for obvious reasons of stable propagation and large bandwidth. Interest in meteor scatter communication has been revitalized as a result of rapid advances in microcomputer technology and digital communication techniques. Some suggested uses for modern meteor scatter communication systems include automatic data collection from unmanned sites, thin-line digital radiolinks, where privacy and exclusive ownership of the communication terminals are essential. Meteor scatter could also be a candidate mode for operation of digital HF communication systems with extended frequency range of operation into the VHF band. The aim of this paper is to present an overview of the meteor scatter propagation mechanism, and the ongoing research efforts which are directed towards the exploration of the potential of meteor scatter propagation as a communication channel. Author

N87-18709# North Atlantic Treaty Organization, Brussels (Belgium). Allied Radio Frequency Agency.
VHF/UHF/MICROWAVE LOS TERRESTRIAL PROPAGATION AND SYSTEM DESIGN
T. K. Fitzsimons *In* AGARD and Special Course on Interaction of Propagation and Digital Transmission Techniques Oct. 1986 11 p (For primary document see N87-18703 11-32)
Avail: NTIS HC A14/MF A01

The telecommunication frequency range under discussion is from 30 MHz up to tens of GHz. For military communications this means the use of systems such as Combat Net Radio, Single-Channel Radio Access, Tactical and Fixed Radio Relay, Air-Ground-Air Systems, Common User Information Systems and Tactical Satellite. For civil communications the systems are not dissimilar - mobile radio, fixed radio relay systems, Air Traffic Control, etc. Of course there is a considerable amount of broadcasting and there are military and civil radar systems in these frequency bands. The spectrum range from 30 MHz to about 5 GHz is for the military in particular, prime spectrum; wide bandwidths (hence digital transmission) can be achieved, most propagation mechanisms are relatively stable and most of this part of the spectrum can be used by tactical systems either operating on the move or moving frequently to new sites. In addition to considerations of wanted performance and necessary characteristics such as ECM, the military systems are designed to meet requirements for rapid deployment in an environment which is difficult and unpredictable from the electromagnetic environment, topographic, and meteorological aspects. Author

N87-18710# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
UHF/SHF SATCOM PROPAGATION AND SYSTEM DESIGN
Allen L. Johnson *In* AGARD and Special Course on Interaction of Propagation and Digital Transmission Techniques Oct. 1986 18 p (For primary document see N87-18703 11-32)
Avail: NTIS HC A14/MF A01

One year after the launch of the Russian Sputnik, the Americans orbited the world's first active communications satellite, SCORE. The communications planners hoped that the line-of-sight communications through satellites would overcome the various propagation problems plaguing long-distance High Frequency (HF) communications. The communications satellite did overcome many of the traditional HF problems but due to the law of conservation of difficulty, a new set of propagation problems emerged. This section deals with some of those problems. A satellite orbiting at approximately 19,200 nautical mile altitude rotates at the same rate as the Earth and, if in an equatorial plane, appears to remain fixed over one point on the Earth. The equatorial synchronous satellite is discussed. The Earth-to-satellite link experiences a variety of propagation effects such as free space loss, attenuation, polarization changes, refraction, and delay as a result of the physics of the link and the normal Earth's atmosphere. These are also discussed. Author

N87-18711# North Atlantic Treaty Organization, Brussels (Belgium). Allied Radio Frequency Agency.
PROBLEMS OF SPECTRUM MANAGEMENT AND SYSTEM COMPATIBILITY
T. K. Fitzsimons *In* AGARD and Special Course on Interaction of Propagation and Digital Transmission Techniques (date) 10 p (For primary document see N87-18703 11-32)
Avail: NTIS HC A14/MF A01

The problems of radio frequency spectrum management stem basically from requirements that are increasing more rapidly than our ability to exploit certain parts of the spectrum. The expanding demand is caused partly by the transition from analog to digital transmission methods but of course also to the increase in communications needs and uses. Much of the increase in demand is for allotments and assignments in frequency bands already

heavily exploited. New frequency bands are periodically added to the table of allocations by the ITU (International Telecommunication Union) and the rate at which this has happened in the recent past is itself an indication in the almost explosive growth in the uses of the radio frequency spectrum. Author

N87-18712# Sandia National Labs., Albuquerque, N. Mex.
STATISTICAL MEASURES OF CLIPPED RANDOM SIGNALS
T. L. Paez and D. O. Smallwood 1986 14 p Presented at the 57th Shock and Vibration Symposium, New Orleans, La., 14 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE87-000978; SAND-86-1179C; CONF-8610140-5) Avail: NTIS HC A02/MF A01

Substantial and yet difficult to detect errors may occur if random data are clipped and then filtered. For stationary random processes formulas are presented for the spectral density (power spectrum) of the clipped and filtered random process in terms of the spectral density of the original random process, the clipping level, and the gain characteristics of the filter. A nonstationary random process that is formed by summing components, each of which is a stationary, band-limited random process modulated by a deterministic function of time, is also analyzed. Estimates of the mean square output (the clipped and filtered input) are given. Examples are given that illustrate the problem of difficult to detect errors for both stationary and nonstationary cases. An overload detector is suggested which could significantly reduce the probability of this error. DOE

N87-18713# Sandia National Labs., Albuquerque, N. Mex.
METHODS FOR DEVELOPING JAM-RESISTANT SECURITY COMMUNICATIONS NETWORKS AT FIXED-SITE FACILITIES
D. J. Gangel, J. E. Heustess, and M. K. Snell 1986 5 p Presented at the International Carnahan Conference on Security Technology, Gothenburg, Sweden, 12 Aug. 1986
(Contract DE-AC04-76DP-00789)
(DE86-015743; SAND-86-0113C; CONF-860884-3) Avail: NTIS HC A02/MF A01

Considerable work has been done identifying and developing equipment and procedures that can be used to improve the survivability of a security communications network during a jamming assault. Insight is given into alternate communications methods that can be used to develop resistance to jamming by supplementing existing radio communications. The spatial properties of jamming are then discussed and examples of how these properties can be exploited are examined. Also discussed are spread-spectrum radios that are highly resistant to jamming and the importance of jamming exercises. DOE

N87-18714# Sandia National Labs., Albuquerque, N. Mex.
HIGH SPEED OPTICAL ISOLATOR FOR RADAR APPLICATIONS
J. P. Anthes, P. Garcia, K. Y. Lau, and I. Ury 1987 5 p Presented at the IEEE/OSA Topical Meeting on Picosecond Electronics and Optoelectronics, Lake Tahoe, Nev., 14 Jan. 1987 Prepared in cooperation with Ortel Corp., Alhambra, Calif.
(Contract DE-AC04-76DP-00789)
(DE86-015824; SAND-86-1896C; CONF-870114-1) Avail: NTIS HC A02/MF A01

A high-speed unidirectional electronic coupler/switch that utilizes optoelectronic components is demonstrated. High attenuation of counter propagating radar signals offers improved radar performance. DOE

N87-18715# Lawrence Livermore National Lab., Calif.
NONLINEAR COUPLING OF HIGH-POWER MICROWAVES IN APERTURES
J. H. Yee, G. S. Sieger, and D. J. Mayhall Nov. 1986 23 p Presented at the 3rd National Conference on High Power Microwave Technology for Defense Applications, Albuquerque, N. Mex., 1 Dec. 1986
(Contract W-7405-eng-48)
(DE87-003255; UCRL-95668; CONF-861240-2) Avail: NTIS HC A02/MF A01

We used numerical calculations to determine the effects of air-breakdown on the coupling of intense microwave pulses passing through apertures. Our calculations are based on a set of Maxwell equations and electron-fluid equations. Results show that the air-breakdown threshold energies in apertures have a functional dependency on pressures similar to that of air-breakdown threshold energies in the atmosphere. We present variations of the transmitted energies of intense microwave pulses passing through apertures as a function of incident-field intensity and aperture size. The effects of secondary emission on the air-breakdown threshold energies around apertures are also discussed. DOE

N87-18716# Lawrence Livermore National Lab., Calif.
NONLINEAR CONDUCTIVITY INDUCED BY THE PASSING OF LONG INTENSE em PULSES (50 TO 500 NS) NEAR THE EARTH'S SURFACE AND IN SF
J. H. Yee, G. H. Khanaka, and D. J. Mayhall Nov. 1986 18 p Presented at the 3rd National Conference on High Power Microwave Technology for Defense Applications, Albuquerque, N. Mex., 1 Dec. 1986
(Contract W-7405-eng-48)
(DE87-003397; UCRL-93077; CONF-861240-3) Avail: NTIS HC A02/MF A01

Two one-dimensional computer codes have been developed to study the passage of long intense microwave pulses through the atmosphere and SF6. The objectives are to obtain information about the electron conductivity and density as well as plasma frequency during the passage of microwave pulses in such media. In the computer model, electrons are treated as a fluid, and their effect on the passing microwave pulse are determined via the simultaneous solution of Maxwell's equations and the electron fluid equations. The model should give fairly accurate predictions, because it takes into account such variables as ambient electron density, beam intensity, ionization (avalanche) and attachment rates, and pressure. DOE

N87-18717# Kaiserslautern Univ. (West Germany). Fachbereich Elektrotechnik.
DISCRIMINATION BETWEEN MAIN AND SIDELOBE RECEPTION IN THE TRANSMISSION OF BROADBAND SIGNAL FORMS BY DIRECTIONAL ANTENNAS Ph.D. Thesis [DISKRIMINIERUNG ZWISCHEN HAUPT- UND NEBENKEULENEMPFANG BEI DER UEBERTRAGUNG BEITBANDIGER SIGNALFORMEN UEBER RICHTANTENNEN]
Peter Rausch 1985 213 p In GERMAN
(ETN-87-99013) Avail: NTIS HC A10/MF A01

The problem of sidelobe reception in the use of directional antennas in radio systems for position finding and navigation was investigated. The transmitting antenna was a homogeneous, rectangular aperture; the receiving antenna was assumed to be ideally isotropic; the transfer function of the transmission channel was calculated. The angle-dependent distortion of the received signal form was studied; no distortion is found in the main radiation direction. The received signal is in general the superposition of the useful and a perturbation signal. A method for the discrimination between main and sidelobe reception is proposed. The recognition probability with this discrimination was calculated. The post-integration method from the radar technique was necessary to obtain a probability higher than 0.7. ESA

N87-18718# Institut National Polytechnique, Grenoble (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
NOISE SUBTRACTORS: STUDY OF A COMPARISON METHOD [SOUSTRACTEURS DE BRUITS. ETUDE D'UNE METHODE DE COMPARISON]
D. Baudois, P. Lorenzino, and A. Silvent 29 Apr. 1986 44 p In FRENCH
(CEPHAG-19/86; ETN-87-99033) Avail: NTIS HC A03/MF A01

An experimental noise reduction comparison method is proposed based on using simulated signals. The learning curve of the adaptation time and the residual error power are studied,

resulting in a procedure to characterize the performance of a noise subtractor. ESA

N87-18719# Institut National Polytechnique, Grenoble (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
SEPARATION OF VERY SHORT PERIOD (VSP) WAVE MODES USING TRACE-BY-TRACE FILTERING
J. L. Mari, F. Coppens, F. Glangeaud, and P. Durand 1986 56 p (CEPHAG-31/86; ETN-87-99039) Avail: NTIS HC A04/MF A01

Three algorithms for the separation of upgoing and downgoing seismic waves that only need two neighboring traces and the first arrival times are presented. They are therefore independent from very short period (VSP) depth-spacing. Performance is evaluated in terms of signal-to-noise ratio, limits of upgoing wave detection, and sensitivity to first arrival peaked times estimate. The algorithms can be used for VSP, check VSP, offset VSP, and can take into account the dip of the reflectors. Results obtained on synthetic and real data are discussed. Which of the three algorithms should be used depends on data quality and which part of the signal has to be focused. ESA

N87-18720# Institut National Polytechnique, Grenoble (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
EXPERIMENT TBF 82. TRACING THE F(T, TAU) FUNCTIONS OF THE PSK SIGNAL RECEIVED AT THREE DIFFERENT WATER IMMERSION DEPTHS [EXPERIMENTATION T.B.F. 82 TRACE DES FONCTIONS F(T, TAU) POUR LE SIGNAL PSK RECU A 3 IMMERSIONS DIFFERENTES]
F. Vial 1986 21 p In FRENCH
(CEPHAG-44/86; ETN-87-99040) Avail: NTIS HC A02/MF A01

A sequence of a 60 Hz carrier phase shift modulated acoustic signals was transmitted at 35m underwater depth and received at 3 different depths. The receiving ship was 140 km from the transmitting ship. The digitized recorded signal was processed using the Surfca-3-Hydros computer program. The signal processing and the electronic circuit implementation are described. Detailed graphic results are given. ESA

N87-18721# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Avionics Panel.
MULTIFUNCTION RADAR FOR AIRBORNE APPLICATIONS
Loughton, England Jul. 1986 209 p In ENGLISH and FRENCH Symposium held in Toulouse, France, 14-18 Oct. 1985
(AGARD-CP-381; ISBN-92-835-0395-3) Avail: NTIS HC A10/MF A01

The present state-of-the-art of multifunction radar and new concepts for the design of future radar systems are presented. Specific subject areas addressed include all-weather operation, signal processing, high resolution imaging (synthetic aperture radar), beam steering, range and Doppler estimation, clutter and interference, equipment and component design, target detection and classification, multifunction integration, and radar system integration. For individual titles, see N87-18722 through N87-18760.

N87-18722# Thomson-CSF, Paris (France).
ABOUT THE FUTURE OF AIRBORNE RADAR
Michel H. Carpentier *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 6 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The present state-of-the-art of airborne multifunctional radar is reviewed and possible developments for future systems are discussed. The operational requirements of military aircraft radars are outlined with particular attention given to target acquisition and tracking, radar navigation and terrain following. The electromagnetic environments these systems will operate in are also characterized. The limitations of present radars are defined and suggestions are made regarding the directions of future research. Four possible areas of development are addressed: (1) improvement of the range resolution and complexity of the transmitted waveforms; (2) better utilization of the received signals; (3) improvement of angular domain; and (4) cooperation with the electromagnetic countermeasure system and other sensors onboard the aircraft. M.G.

N87-18723# Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
SOLID STATE MULTIFUNCTION PHASED ARRAY RADAR
W. D. Wirth *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 8 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

With an experimental phased array radar system ELRA (electronic steerable radar) operational experience has been gathered. This system was planned for solid state operation, therefore it consists of active receiving and transmitting arrays. The provisional tube power amplifiers are replaced by transistor amplifiers. This change had some implications on the multifunction operation, especially on the selection of transmitted waveforms. The necessary considerations are relevant for future solid state phased array radars. The introduction of monolithic microwave antenna modules will improve the chances of active solid state phased arrays. Author

N87-18724# Radar Systems Group, Los Angeles, Calif. Advanced Development Dept.
MULTIMISSION AIRBORNE RADAR FOR THE 1990S
Thomas H. Robinson *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 2 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The continuing trend towards the development and production of aircraft capable of multiple missions indicates that future airborne radars must provide a broad spectrum of air-to-air and air-to-ground modes. This paper investigates the modal and functional requirements of a multimode radar projected for the mid-1990s period. The paper is divided into two sections. In the first, the multimission capabilities of current radars are presented to establish trends and capabilities. In the second, the requirements of the next generation system are established. Current multimode radars lay the basis for future systems. The experience gained on the APG-65 and APG-63/70 radars is presented and conclusions are drawn regarding their impact on future system requirements. Not only are modes and performance reviewed for these radars but also their system architecture. The discussion starts with the APG-65 radar which is the first true multimission radar with programmable signal and data processing. Following this, the evolution of the APG-63 radar, culminating with the most recent upgrading resulting in redesignation of APG-70, is presented. The incorporation of air-to-ground capabilities in the APG-70, resulting from the Dual Role Fighter program, is reviewed. Results from the Advanced Fighter Capabilities Demonstration program are presented showing how high resolution SAR was incorporated into a full weapon delivery solution. The specific radar requirements for the next decade radar system are developed. This development is done in two parts. First, mode requirements are synthesized for air superiority, navigation and strike/interdiction operation. This includes low altitude penetration requirements and a review of radar timeline constraints which arise. Second, the fundamental functional requirements needed to implement the mode requirements are explored. Architectural issues and their impact on reliability and sustainability are also considered. Author

N87-18725# Royal Signals and Radar Establishment, Malvern (England).
MULTIFUNCTION MILLIMETRE-WAVE RADAR FOR ALL-WEATHER GROUND ATTACK AIRCRAFT Abstract Only
K. E. Potter *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Details of the millimeter wave radar performance are presented which show that with potentially available power sources an all weather capability can be realized. Performance is evaluated as a function of frequency and antenna size, and the use of polarimetry with wide bandwidth/coherent processing is shown to offer potential enhancement for target discrimination. The millimeter

wave radar is shown to be potentially capable of satisfying the following functions: take off/landing, terrain following, area correlation, tercom, and acquisition of targets. The above roles can be achieved in an all weather environment making the millimeter wave radar a valuable multifunction airborne radar.
Author

N87-18726# Rome Air Development Center, Griffiss AFB, N.Y.
MULTI-MODE MULTISTATICS FOR PASSIVE/ACTIVE AIRBORNE SURVEILLANCE Abstract Only
Robert F. Ogrodnik *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The increasing performance demands for air surveillance assets, as well as the necessity for continued surveillance operations in the presence of enemy jamming anti-radiation missile (ARM) attacks, have increased interest in passive surveillance, in particular multi-mode passive/active multistatic sensing. The use of noncooperative radiation as illuminators of opportunity combined with passive surveillance electromagnetic support measurement (ESM) sensors opens new horizons to multistatic surveillance from a passive airborne platform. Research and field tests have been conducted on ESM augmented bistatics as well as noncooperative multistatics which support the development of airborne multi-mode passive surveillance technology. This work has been conducted under such programs as the Bistatic Enhanced Altimeter Detection (BEAD) and the noncooperative multistatic Passive Coherent Location (PCL). Both BEAD and PCL technology directly support the receiver, signal processing and target location/tracking operations necessary for passive surveillance. The demonstrated technologies for EM interference rejection and multistatic multi-target tracking and location under PCL provide a promising performance bench mark for passive surveillance in the presence of a complex electromagnetic environment. Passive receiver intercept performance under BEAD has provided a receiver design baseline for both look-down and look-up surveillance applications. The technologies under development in BEAD and PCL are presented along with the field test results and the sensor concepts. In particular, spin-off data such as bistatic look-down clutter, noise-floor limitation of noncooperative multistatics and sensitivity limitations set by passive surveillance using signal intercept techniques and illuminators of opportunity are provided. Author

N87-18727# Huntec 70 Ltd., Scarborough (Ontario).
MOTION COMPENSATION REQUIREMENTS FOR A HIGH RESOLUTION SPOTLIGHT SAR Abstract Only
J. S. A. Hepburn, G. E. Haslam (Defence Research Establishment, Ottawa., Ontario), D. F. Liang, and W. S. Widnall (Massachusetts Inst. of Tech., Cambridge) *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The Canadian Department of National Defence is developing a high resolution airborne spotlight synthetic aperture radar (SAR). To attain the high contrast, high resolution and low geometric distortion objectives of the project, it is essential that very accurate motion compensation be applied to the radar returns to minimize the effects on SAR image quality of spurious antenna phase center motion. The motion compensation system being developed for the project includes a gimballed master inertial navigation system (INS) located near the center of gravity of the host aircraft, a strapdown inertial measurement unit (IMU) comprising gyroscope and accelerometer triads mounted on the radar antenna, as well as Doppler velocity and barometric altitude sensors for damping the inertial systems. The role of the master INS is to enable high accuracy alignment of the strapdown IMU. The raw sensor data are integrated using a U-D factorized Kalman filter to obtain optimal estimates of the motion of the radar antenna phase center while the SAR window is open. The data are used to adjust both the radar pulse repetition frequency and the phase and displacement of the radar returns. An analysis of the motion compensation requirements was carried out, leading to the specification of the motion compensation sensor configuration and accuracy. The performance of the motion compensation system has been evaluated by detailed computer simulation. This evaluation accounted for all major system error sources, including errors associated with sensors, transfer alignment and computation, with the system operating in a moderately turbulent environment.
Author

N87-18728# Defence Research Establishment, Ottawa. (Ontario).
IMPLEMENTATION OF AN AIRBORNE SAR MOTION COMPENSATION SYSTEM Abstract Only
D. DiFilippo, D. F. Liang, L. Postema (Lear Siegler, Inc., Grand Rapids, Mich.), and B. Leach (National Aeronautical Establishment, Ottawa, Ontario) *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The Canadian Department of National Defence has entered into the Phase 2 development of an airborne synthetic aperture radar motion compensation (SARMC) system, following a Phase 1 feasibility study which led to the specification of the SARMC sensor configuration and accuracy. This paper describes the hardware and software configurations of an airborne SARMC system implemented on board a Convair 580 research aircraft. The hardware configuration includes a gimballed LTN-51 inertial navigation system, a Decca Doppler radar, a baroaltimeter and a motion compensation inertial measurement subsystem (MCIMS). The MCIMS is a specially designed strapped-down inertial measurement unit mounted on the ring gear of the APS-506 radar antenna. Since motion compensation depends critically on knowledge of the MCIMS orientation with respect to the radar line-of-sight to the designated target, a laser alignment procedure was developed and performed to calibrate the azimuth encoder of the antenna ring gear. This procedure is discussed along with experimental results. Substantial effort was dedicated to streamlining the Kalman filter algorithms in the SARMC processing package to obtain a high degree of robustness and computational efficiency while optimally integrating the information from the motion compensation sensors. Preliminary flight trial data are presented and compared with simulation results to indicate the level of performance achievable with this optimized system. Author

N87-18729# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. for Radio Frequency Technology.
MM WAVE SAR SENSOR DESIGN: CONCEPT FOR AN AIRBORNE LOW LEVEL RECONNAISSANCE SYSTEM Abstract Only
C. Boesswetter *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The basic system design considerations for a high resolution SAR system operating at 35 GHz or 94 GHz are given. First it is shown that only the focussed SAR concept in the side looking configuration matches the requirements and constraints. After definition of illumination geometry and airborne modes the fundamental SAR parameters in range and azimuth direction are derived. A review of the performance parameters of some critical mm wave components (coherent pulsed transmitters, front ends, antennas) establish the basis for further analysis. The power and contrast budget in the processed SAR image shows the feasibility of a 35/94 GHz SAR sensor design. The discussion of the resulting system parameters points out that this unusual system design implies both benefits and new risk areas. One of the benefits besides the compactness of sensor hardware turns out to be the short synthetic aperture length simplifying the design of the digital SAR processor, preferably operating in real time. A possible architecture based on current state-of-the-art correlator hardware is shown. One of the potential risk areas in achieving high resolution SAR imagery in the mm wave frequency band is motion compensation. However, it is shown that the short range and short synthetic aperture lengths ease the problem so that

correction of motion induced phase errors and thus focussed synthetic aperture processing should be possible. Author

N87-18730# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. for Radio Frequency Technology.

ECCM EFFECTIVENESS OF A LOW SIDELOBE ANTENNA FOR SAR GROUND MAPPING Abstract Only

C. Boesswetter *In* AGARD Multifunction Radio for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)

Avail: NTIS HC A10/MF A01

Airborne synthetic aperture radar (SAR) reconnaissance systems in the strip mapping mode are susceptible to jamming. The main electronic counter measure (ECM) threat is commonly understood to be the ground based sidelobe jammer which includes a sensitive intercept receiver and a tracking capability to adapt the jamming power in angle, frequency and bandwidth to the SAR system. The most important of several necessary electronic counter-countermeasure (ECCM) techniques is commonly considered to be a low sidelobe SAR antenna which also improves MTI performance. To characterize the ECCM and cost effectiveness of such an expensive antenna some measures are needed. There are two separate phases: intercept and jamming. Accordingly, two gains are defined: intercept gain and jamming gain. Both are based on the evaluation of the signal-to- (jammer plus clutter plus noise) ratio in the processed SAR image for the configuration airborne sensor-ground based jammer. Both gains descibe the benefits of a low side lobe antenna in terms of jam-free flight distance (intercept) and target contrast enhancement (jamming). It is shown that in the most interesting case of heavy jamming both intercept and jamming phases are discribed by the same set of equations if normalized to the pointing direction R sub 0 of the antenna. It follows that the intercept ratio on the ground equals the reciprocal of the target contrast in the processed SAR image. To discuss both the intercept and jamming gain performance of a given SAR antenna 3-dimensional relief plots and 2-dimensional contour plots are used. They allow the definition of both gains directly. For the parameters of a given SAR reconnaissance system the plots are calculated in an area of 120 nmi x 180 nmi (azimuth x range). By replacing the existing antenna with uniform weighting with an antenna with 25 dB lower sidelobe level the ECCM effectiveness in terms of intercept gain and jamming gain is shown. Since the equations are normalized to the pointing direction of the sensor antenna the results are given in relative terms. By including actual jammer parameters the ECCM effectiveness may also be given in absolute terms.

Author

N87-18731# Thomson-CSF, Malakoff (France). Div. A.V.S.

SYNTHETIC APERTURE IMAGING AIRBORNE RADAR

Marc Lucas *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 4 p Previously announced as A86-32632 (For primary document see N87-18721 11-32)

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Airborne synthetic aperture radars are systems able to obtain high resolution ground images, by day or night, independent of weather conditions. Their applications are very broad, both military (reconnaissance), and civilian (mapping, remote sensing). Following a brief technical account (synthetic aperture, pulse compression), the paper describes the operational features of an airborne radar system providing high resolution images at long range. Then, a technical description is given. This system can provide in real time, to the ground, radar images by using a high rate data link. It consists of two main parts: (1) an airborne part including the antenna, the radar transmitter-receiver, and the data link unit; and (2) a ground station that realizes, in real time, data reception, synthetic aperture processing, and image exploitation. IAA

N87-18732# Forschungsinstitut fuer Hochfrequenzphysik, Werthoven (West Germany).

MILLIMETER WAVE TRANSMISSION THROUGH MAN-MADE OBSCURATIONS IN A BATTLEFIELD ENVIRONMENT Abstract Only

H. Essen and E. P. Baars *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)

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It is quite well established that millimeter waves exhibit superior transmission features for natural obscurations, i.e., mostly adverse weather-effects, if compared to those in the IR-region. Therefore mm-wave systems are competitors for military surveillance and guidance systems. For these applications the knowledge of the amount of degradation of mm-systems due to obscuration in a battlefield environment has to be assessed in comparison to IR-sensors. The data dealt with in this paper have been gathered during various measurement campaigns. They cover smoke and dust trials with mm-wave instrumentation systems at 47 GHz and 94 GHz and experiments on screening smokes. All trials were performed in conjunction with IR-measurements. For the dust and smoke-trials a bistatic configuration was used with transmitters and receivers located at two opposite sites across an artillery impact area. Results are discussed by means of attenuation-curves for different transmit/receive-polarizations. A comparison of the results of the two employed mm-wave frequencies with the simultaneously measured IR-data is given for selected events and on a statistical basis over the whole measurement period. For the experiments on screening smokes a monostatic configuration was chosen with a pulsed 94 GHz instrumentation radar operating over a folded transmission path against a corner reflector and armoured target vehicles. By recording the echos from a number of consecutive range gates the attenuation caused by the smoke as well as the backscatter of the smoke cloud and the location of scattering centers within the cloud could be evaluated. Author

N87-18733# Adaptive Sensors, Inc., Santa Monica, Calif.

A CFAR DESIGN CONCEPT FOR OPERATION IN HETEROGENEOUS CLUTTER

Harold M. Finn *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 12 p Sponsored by the Army (For primary document see N87-18721 11-32)

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When the heterogeneous clutter field spanning the spatial sampling sliding window can be modeled as two contiguous homogeneous clutter fields with the statistical parameters of each field unknown and independent from field to field and with the transition point between fields also not known, then the cell averaging CFAR (constant false alarm rate) performance significantly degrades yielding target masking effects and loss of false alarm regulation. For the same defined and encountered environment spanning the sliding windows, the performance degradation effects are shown to be largely eliminated when a newly developed class of CFAR test is employed designated as heterogeneous clutter estimating CFAR's (HCE-CFAR). The test initially involves the combined use of multiple hypothesis testing and maximum likelihood estimation procedures to estimate the statistical parameters of each of the two fields, and the transition point between them, and then makes use of the relevant estimated clutter field parameters to effect the final decision rule. HCE-CFAR designs are presented for both the cases when the contiguous fields have Rayleigh first order probability distritubions, and log normal probability distribution. However, the focus of the development and the conducted performance evaluation is for the Rayleigh clutter cases. Author

N87-18734# Marconi Co. Ltd., Chelmsford (England).

HIGH-RESOLUTION MTI WITH SAR Abstract Only

A. Freeman *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)

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Moving Target Imaging (MTI) using Synthetic Aperture Radar (SAR) offers considerable potential as an all-weather surveillance tool, monitoring the movement of vehicles on the ground. The purpose of the work described in this paper is to investigate techniques of producing high-resolution images of such moving objects using the radar signals received by an existing airborne

SAR system. The first step in the MTI method adopted is the production of a rather crude image of such moving targets as exist in the data. This can be achieved by application of a simple prefilter (for clutter-cancellation) prior to the conventional azimuth (Doppler) processing. The image can then be used for initial detection of the targets. In such images, well-behaved moving targets are distorted by their motions in a particular manner and the parameters of the target motions can be estimated from their shape and other properties. These parameters are measured and then used to construct a 2-dimensional filter matched to the response for each target, for use in the azimuth (Doppler) processing. This technique can be shown to produce high-resolution images of the moving targets with resolution being comparable to that of the conventional airborne SAR images of the ground.
Author

N87-18735# Adaptive Sensors, Inc., Santa Monica, Calif.
A SEQUENTIAL ADAPTATION TECHNIQUE AND ITS APPLICATION TO THE MARK 12 IFF SYSTEM
John S. Bailey, John D. Mallett, Duane J. Sheppard (Army Electronics Research and Development Command, Fort Monmouth, N. J.), F. Neal Warner, and Robert Adams (Technology Service Corp., Santa Monica, Calif.) *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 11 p (For primary document see N87-18721 11-32)
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Sequential adaptation uses only two sets of receivers, correlators, and A/D converters which are time multiplexed to effect spatial adaptation in a system with (N) adaptive degrees of freedom. This technique can substantially reduce the hardware cost over what is realizable in a parallel architecture. A three channel L-band version of the sequential adapter was built and tested for use with the MARK XII IFF (identify friend or foe) system. In this system the sequentially determined adaptive weights were obtained digitally but implemented at RF. As a result, many of the post RF hardware induced sources of error that normally limit cancellation, such as receiver mismatch, are removed by the feedback property. The result is a system that can yield high levels of cancellation and be readily retrofitted to currently fielded equipment. Author

N87-18736# General Electric Co., Utica, N.Y. Aerospace Electronic Systems Dept.
HIGH RESOLUTION SIGNAL PROCESSOR FOR LIMITED APERTURE MULTIMODE RADAR
Robert L. Nevin and M. R. OSullivan (O'Sullivan Consulting, Inc., Rancho Palos Verdes, Calif.) *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 10 p (For primary document see N87-18721 11-32)
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The maximum attainable point target detection capability of a search radar in a receiver noise limited situation is fundamentally limited by the radar's power-aperture product. However, the degree to which practical systems approach this maximum performance may be limited by processor power (i.e., processor throughput, resolution, etc.). Furthermore, in clutter limited situations, such as air-to-air look-down search modes, greater processor resolution, in both range and Doppler, can reduce the effective size of the clutter cell competing with the target, and thereby improve subclutter visibility. Recent and ongoing developments have contributed to the application of high-resolution, high-throughput signal processing to multimode, multifunction airborne radars. Both air-to-air and air-to-ground modes benefit in performance from increased processing power and flexibility. The solution to the high resolution processor is based on the experimental Modular Survivable Radar developed by General Electric in the late 1970s, and extended to airborne multimode radar projects. This modular, reconfigurable pipeline consists of high-efficiency stages, each with a narrow range of assigned functions, cascaded to form the full signal processor. Experience in system integration and testing has proven the adaptability of this architecture, which can be particularly useful to achieve the detection range requirements in a small fighter aircraft where physical space and cooling capability limit the power and aperture available to the radar. The architecture of a Programmable Signal Processor (PSP) currently in development for future application is described. This architecture allows Processing Elements (PE's) and memory elements to be configured into parallel pipelines. The PE's are designed to perform linear and nonlinear operations at the same high throughput rate. These features make it highly suitable for integration into the radar signal processor. With respect to this integration, the degree of flexibility required at different points in the pipeline is considered. Author

N87-18737# Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
ANGULAR SUPER-RESOLUTION WITH ARRAY ANTENNAS: APPLICATION TO SEEKER-HEADS Abstract Only
U. Nickel *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Monopulse seeker-heads can give large errors due to closely spaced targets or even completely wrong directions in the case of cross-eye deception. The effective countermeasure against these errors is resolution enhancement. Super-resolution methods offer the possibility to resolve targets closer than the antenna beamwidth. Such methods are favorable for seeker-head applications, because the target separation as well as the signal-to-noise ratio increases as the missile approaches the target. All effective super-resolution methods require an antenna array with access to the single element outputs. Thus mechanical scanning is replaced by electronic scanning. Depending on the type of missile, sometimes antenna pattern restrictions have to be tolerated. Among all super-resolution methods the parametric target model fitting (PTMF) method seems to be most appropriate for this application. This method tries to fit a completely parameterized target model directly to the measured data. It can be rather easily computed, and it is the only method which can resolve completely correlated targets, which arise in the case of multipath and cross-eye deception. For seeker-heads with few antenna elements an implementation with digital signal processor chips is most suited. Computer simulations and experiments with measured data using the DESAS test equipment show that two targets separated at 0.3 beamwidth can be resolved in azimuth and elevation and that the switch from conventional monopulse to two-target estimation (super-resolution), which is crucial for the approaching missile, can be done by a reliable automatic test procedure. Author

N87-18738# Thomson-CSF, Montrouge (France). Division Equipements Avioniques.
DYNAMICS AND SIGNAL PROCESSING ALGORITHMS FOR HIGH FREQUENCY OF RECURRENCE RADAR MODES [DYNAMIQUES ET ALGORTHMES DE TRAITEMENT DU SIGNAL DANS LES MODES RADAR A HAUTE FREQUENCE DE RECURRENCE]
Philippe Lacomme *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 6 p In FRENCH (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The dynamics problem in the processing of signals is particularly difficult in the case of high frequency of recurrence (HFR) radar modes. Reception dynamics and necessary signal processing are defined and a typical case is evaluated. The effects of quantification are then analyzed at the various stages of signal processing (coding, rejection filtering, Fourier transformation). It is shown that the quantification noise depends, to a large extent, on the processing algorithms utilized. The presence of a ground echo rejection filter can directly increase the truncation problems owing to the elements situated after the filter. Likewise, the various algorithms used to compute the Fourier transform (fast Fourier transform or Winograd Fourier transform) function very differently vis-a-vis the truncations carried out with the operators. Therefore, in the selection of processing algorithms, it is necessary to consider, not only their performances with regard to the number of elementary operations, but also their sensitivity to quantification noise. M.G.

N87-18739# Rome Air Development Center, Griffiss AFB, N.Y.
DIGITAL AND OPTICAL SYSTOLIC ARCHITECTURES FOR AIRBORNE ADAPTIVE RADARS
Stanley Lis, Vincent C. Vannicola, John A. Graniero, Barry P. Medoff (Electromagnetic Systems Labs., Inc., Sunnyvale, Calif.), and William A. Penn (General Electric Co., Syracuse, N.Y.) *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 13 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Systolic architectures for digital and analog, electronic and optical signal processing are presented along with specific applications to adaptive nulling. It is shown how the various architectures provide for the implementation of adaptive algorithms and how technologies affect performance. Their effects on adaptive degrees of freedom, convergence time, null depth, signal to noise ratio are presented along with size, weight, and required power. Adaptive algorithms covered are of two basic types: feedback/iterative and direct methods. Examples of each include the least mean square (LMS) for the iterative type and the QU factorization based on the Givens method for the direct method. Simulation results have verified the performance of the least squares and the systolic array for QU factorization by Givens method. Improved performance was obtained using the modified minimum variance distortionless response algorithm based on the maximum likelihood criteria. An optical implementation of the least squares algorithm over a continuously adaptive multi-path was experimentally evaluated. Thus far, 24 dB of cancellation was achieved over a 7 micro-second multi-path window for 10 mega-Hertz instantaneous bandwidth. Adaptivity in the spatial, temporal and Doppler domains are illustrated and their embodiment into the various architectures are presented. For example, an analog optical processor which generates weights in the spatial and temporal (multi-path) domains for broadband systems is shown. Also shown is a digital systolic architecture which is applied to a direct decomposition method for generation of adaptive weights in the spatial and Doppler domains. A description of brassboard models representing both architectures is included. Author

N87-18740# Marconi Avionics Ltd., Basildon (England). Signal Processing Design Dept.
THE APPLICATION OF MULTI-DIMENSIONAL ACCESS MEMORIES TO RADAR SIGNAL PROCESSING SYSTEMS Abstract Only
David Hayes and Bill Strawhorne *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

A multi-dimensional access memory (MDAM) allows a word to be accessed from store either in the manner it was entered or as part of a bit slice of equally spaced or contiguous words. Conceptually, data may be regarded as being stored in an n dimensional hypercube of side length equal to the word length that usefully maps onto a wide range of signal processing operations, (e.g., FFTs, matrix inversion, multiple moments, distance metrics, sorts, searches and correlation decodes), when associated processing units that can carry out both bit parallel and bit serial arithmetic are used. The mapping of the natural multi-dimensionality of a signal processing task onto the MDAM structure is shown to be particularly useful when bit serial, word parallel processors are employed. In these circumstances the facilities of the MDAM make possible a range of useful operations that could only be implemented with great inefficiency using conventional memories. Furthermore, the MDAM considerably simplifies address generation for the I/O of real and complex words (e.g., the corner turn of incoming samples) while allowing useful permutations, such as barrel shifts, to be applied on each memory access for a insignificant cost in extra circuitry. Highly efficient and deeply pipelined, implementations of MDAM/processor structures are discussed that are particulary well suited to VLSI methodologies, in that very wide bandwidth interconnection networks of high complexity can be achieved at relatively low gate and pin counts. Thus, it is possible to form highly parallel multi-MDAM/processor structures that support very high levels of concurrency, identified as necessary for future radar signal processing systems. Moreover these structures translate over classes of operations that are not normally associated with each other. Consequently, these forms can be made extremely general and modular to produce powerful and compact processing kernels for programmable systems that embody high level signal processing constructs in their VLSI fabric and lead to high performance at the minimum silicon cost. Author

N87-18741# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
ON A SINGLE STEP TECHNIQUE FOR ADAPTIVE ARRAY PROCESSING
Josef Worms *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 6 p (For primary document see N87-18721 11-32)
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An improved adaptation algorithm designed for real time signal processing in antenna arrays is presented. The method is used for determining the filter weights in a sidelobe cancellation system. The Wiener filter equation is solved by using the well known Gauss-Seidel method and a sample matrix estimate. This algorithm (SSM - Single Step Method) combines rapid convergence and numerical stability. Compared with the direct SMI-technique and the Widrow LMS-algorithm, the properties of the proposed algorithm lead us to the conclusion that it is especially well suited for airborne antenna array applications. Author

N87-18742# Thomson-CSF, Montrouge (France). Division Equipements Avioniques.
FORM FACTOR OPTIMIZATION FOR HFR EMISSION [OPTRIMISATION DUE FACTEUR DE FORME EN EMISSION HFR]
Ph. Lebienvenu *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 9 p In FRENCH (For primary document see N87-18721 11-32)
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In high frequency of recurrence (HFR) emission having a weak form factor, eclispes and sampling result in some significant losses of the signal. The object of this paper is to present evaluation methods for these losses, starting with detection probability curves as a function of distance, and to utilize these methods to determine, under certain constraints of emitted power and computation loads, optimum form factors. M.G.

N87-18743# Alabama Univ., Huntsville. Dept. of Electrical and Computer Engineering.
A GENERAL SOLUTION FOR THE SYNTHESIS OF BINARY SEQUENCES WITH DESIRED CORRELATION SEQUENCE
Robert J. Polge *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 9 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Binary sequences are of considerable interest in many applications. In particular, the performance of a radar depends on the ambiguity function. For the case of binary phase modulation, the zero-Doppler performance of a pulse radar is a function of the discrete autocorrelation of the corresponding binary sequence. Alternately, a binary sequence can be expressed as a sequence of runs where the length of a run is equal to the number of contiguous bits of same sign. Given a run pattern the discrete autocorrelation can be computed easily and more rapidly than with the standard technique. The inverse problem, which is the synthesis of a run pattern given the desired discrete autocorrelation sequence, is much more difficult. This paper develops a set of sequential relations which relate the desired autocorrelation sequence to properties of the run pattern. For example, the autocorrelation at lag 1 defines the number of runs for a sequence of specified length. The autocorrelation at lag 2 now determines the number of runs of length 1. More generally the autocorrelation at lag (k+1) establishes a relation between consecutive runs with sum exactly equal to k. Judicious use of these relations greatly facilitates the computer synthesis of binary sequences. While the method is quite general, emphasis is on tracking applications where it is desired to minimize the sidelobes as far as possible. Author

N87-18744# Illinois Univ., Chicago. Communication Lab.
BASIC MONOSTATIC POLARIMETRIC BROADBAND TARGET SCATTERING ANALYSIS REQUIRED FOR HIGH RESOLUTION POLARIMETRIC RADAR TARGET DOWNRANGE/ CROSSRANGE IMAGING OF AIRBORNE SCATTERERS
Bing-Yuen Foo, Sujeet K. Chaudhuri (Waterloo Univ., Ontario), and Wolfgang-M. Boerner *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 10 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

It has been well known that high frequency radar interrogation may disclose fine geometrical as well as indepth material decomposition of radar targets, whereas low frequency interception may only recover such coarse information as target size and target volume. At low frequencies, a target behaves as if it were a point source; within the resonance frequency regime it may disclose its natural frequency structure; and at high frequencies (PO/GO) its geometrical fine structures. Any target descriptor which is intended to describe the geometry becomes somewhat loose in its validity at low and resonant frequencies. For a target descriptor to describe fine geometrical structure, it has to be defined on a high frequency basis. In the phenomenological wideband polarimetric approach of the polarimetric radar target description first introduced by Kennaugh and further extended by Huynen, the proper specification of frequency range of validity has not been pointed out. In both treatments little care was given to this fact, which resulted in a haphazard early rejection of these important high resolution polarimetric radar target imaging theories because the resulting algorithms were incorrectly applied to the total spectral region. In view of these unsubstantiated claims of the complete uselessness of high resolution polarimetric radar imagery, the main objective is to show, based on rigorous electromagnetic vector scattering theory, that the Kennaugh, and particularly the Huynen polarimetric target descriptors, at high frequencies, can be closely related to specular geometry (in particular, specular curvature). For the purpose of verifying our approach the perfectly conducting ellipsoid is considered versus similar spherical target shapes. Numerical verification with measured scattering data for these shapes is shown, and application of the Kennaugh and Huynen target characteristic descriptors in downrange target discrimination, imaging and identification is suggested or demonstrated. Author

N87-18745# Waterloo Univ. (Ontario). Dept. of Electrical Engineering.
MULTI-(BI)-STATIC HIGH FREQUENCY (PO/GO) RADAR TARGET IMAGING OF AIRBORNE SCATTERERS
Sujeet K. Chaudhuri and Wolfgang-M. Boerner (Illinois Univ., Chicago) *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 12 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Electromagnetic scattering at distances remote from a complex-shaped object, at high frequencies (Physical Optics/Geometric Optics), is dominated by certain specular components which are highly bistatic aspect and multifrequency dependent. The locations of these specular points on the complex object are known as the scattering centers. Generation of these scattering centers is dependent on the local geometry and local material in-depth decomposition of the object with respect to the aspect directions of the transmitter and receiver locations (monostatic as well as bistatic cases). The knowledge of the locations and the local geometries plus underlying material decomposition of these scattering centers can be useful in developing air-target discrimination/identification algorithms. Based upon this existing available basic multistatic scattering formulation, which is highly polarization-dependent, a basic vector inverse scattering model can be developed to recover these scattering centers from poly-(bi)-static polarimetric (bistatic scattering matrix) signatures which then may be used to formulate target classification, imaging and identification algorithms. The approach adopted in this investigation is based on the solution to the general poly-(bi)-static high frequency isolated scattering center recovery problem. Once this direct model solution is established and verified with the analytically model-generated and measured model test data, it is used as a building block toward more complicated inverse problems for the following realistic situations: (1) scattering center recovery with aspect/frequency restricted measurements for more economic/ realistic implementation (limited bi/mono-static aspect angles, narrow bandwidth, CW multi-(bi)-static angle data, etc.) for the development of classification/imaging/identification algorithms; and (2) shape/surface material decomposition pattern recognition algorithms based on the knowledge of the recovered distribution of 3-dimensional distributed scattering centers on a complex shape target. Author

N87-18746# Thomson-CSF, Malakoff (France).
TARGET ANALYSIS THROUGH FINE DISTANCE DISCRIMINATION Abstract Only [DISPOSITIF DANALYSE DE CIBLES PAR DISCRIMINATION FINE EN DISTANCE]
R. Ambos *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p In FRENCH (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Fine target analysis as a function of distance requires an emission with an instantaneous wide band spectra, i.e., for a resolution of 50 cm, 300 MHz are necessary. To develop an analysis technique based on pulse compression with linear frequency modulation, it is necessary to develop very strong BT (bandwidth-time) dispersive lines, to encode and process the compressed pulses very quickly. The principle proposed handles these difficulties in the following manner: to develop the strong BT necessary for the emission by utilizing existing dispersive lines resulting from specific analog processing. M.G.

N87-18747# Naval Weapons Center, China Lake, Calif.
CONSIDERATIONS IN UTILIZING IR SIGNATURES Abstract Only c74
Wayne H. Tanaka *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The relationships of RF and IR systems, characteristics of both active and passive IR sensor data, and applications of laser radar sensors are discussed and illustrated with signature data. The radar equation and how it is used by both the RF and laser radar communities are shown including a carrier-to-noise budget analysis performed for both technologies for a proposed altimeter development. This leads to a consideration of the basic features that an active and passive IR sensor can exploit from a target. Issues of background rejection are raised. A general discussion of the types of uses the DOD is considering for laser radars follows. These include altimetry, Doppler navigation, obstacle avoidance for avionics, and remote sensing lidar. Examples of signatures included are forward-looking-infrared (FLIR) data of ships taken under Navy Target Signatures Program (TSP) auspices, active CO2 laser radar signatures of ships, again taken under TSP auspices, within the last two years, and laser radar signatures of tanks and vehicles. Author

N87-18748# Siemens A.G., Munich (West Germany).
THE MIXTURE OF DIFFERENT SEMICONDUCTOR TECHNOLOGIES IN RADAR MODULES AND ITS IMPACT ON COOLING PROBLEMS AND RELIABILITY
Erik Langer *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 8 p (For primary document see N87-18721 11-32)
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The T/R-modules of active phased array radars (PAR) contain electronic circuits made from very different materials and technologies. The power dissipation of the dense packed modules produces much heat in the array which has only moderate cooling conditions. Therefore, the electronic devices must operate at ambient temperatures up to 90 C. Despite careful optimization of the heat paths, junction temperatures can rise up to 160 C. Hence failure mechanisms with high activation energies (e.g., 1.85 eV) are relevant, even through they can normally be neglected for reliability estimations. By optimizing the individual devices one can expect that with soft degradation the mean repair interval

(MRI) of the array will be about 1 to 3 years accumulated service times. The degradation of electrical performance at high temperatures limits only the transmission power and the receiver noise figure. By application of an Arrhenius graph and modification of the bath tube curve, one can derive reliability figures from stress tests with small numbers of samples in an early state of development. The reliability and packaging problems can be solved, so that T/R-modules can meet the requirements of active PAR. Author

N87-18749# Rome Air Development Center, Griffiss AFB, N.Y.
MMIC T/R MODULES FOR THE NEXT GENERATION AIRBORNE SURVEILLANCE PLATFORMS
Edward J. Jones, Michael O. Little, Thomas A. McEwen, R. Hunter Chilton, and Joseph P. Polniaszek *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 6 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Technology for a lightweight low cost transmit/receive (T/R) module for the next generation airborne surveillance phased array radar is described. The T/R module in an active phased array radar is a primary system cost driver; therefore, a low cost, module had to be developed in order to make future phased arrays affordable. Monolithic microwave integrated circuit (MMIC) technology is the technology being developed to fill the above requirement. MMIC technology is an approach wherein all the active and passive elements of the circuit and their required interconnections are formed on a single semiconductor material, e.g., gallium arsenide. MMIC technology appears to be ideal because of the inherent low cost involved with production of integrated circuits. The low production cost is due to the lack of manual handling and assembly, improved reliability, improved reproducibility, small size and weight, circuit design flexibility, and broadband performance. Author

N87-18750# Rome Air Development Center, Hanscom AFB, Mass. Electromagnetic Sciences Div.
LOW-COST, MONOLITHIC BEAMFORMING COMPONENTS FOR RADAR Abstract Only
Paul H. Carr, Scott W. Mitchell, and Richard T. Webster *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Planar, monolithic technology offers the possibility of lowering the cost of beamforming components, which contribute significantly to the high price of phased array radars. The most immediate opportunity for planar technology could be to replace the costly ferrite phase shifters in current use. PIN diode phase shifters have the advantage of faster switching times (sub-microsecond) than ferrites and the disadvantage of slightly higher insertion loss, which is due to the fact that microstrip is inherently more lossy than waveguide. Low cost PIN phasers can be fabricated by monolithic technology or automated, robotic hybrid thick-film techniques. Monolithic phase shifters on GaAs have typical losses of 6 dB and power handling capabilities under a watt. This eliminates them from consideration as replacement for ferrite phasers in the corporate fed arrays considered above. New research results on reducing this insertion loss are presented. The insertion loss is not critical if the phase shifter is followed by an efficient power amplifier. The French have reported on MISFET amplifiers on InP with 33% power added efficiency and a power output at 9 GHz of 4W/mm gate width, which is more than twice that of the best GaAs MESFET. Monolithic technology is especially attractive at mm-wave frequencies, due to the smaller component size and the minimization of parasitics. Results on 44 GHz phase shifters are presented. Electronically variable time delay rather than phase shift is required for low-sidelobe phased arrays having wide instantaneous bandwidth. Monolithic SAW tapped delay lines on GaAs are described for use at center frequencies under 1 GHz. Above 1 GHz, magnetostatic wave devices are capable of continuous variable time delay over a 40 nsec range. Author

N87-18751# Societe d'Etude du Radant, Les Ulis (France).
ELECTRONIC SCANNING ANTENNA FOR MILITARY AIRCRAFT OF THE 1990S Abstract Only [ANTENNE A BALAYAGE ELECTRONIQUE AEROPORTEE POUR AVION DARME DES ANNEES 90]
C. Chekroun *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p In FRENCH (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

A 7-bit electronic scanning antenna has been developed. The possibilities of the wide angular coverage (70 deg cone), the radioelectric performance (transmission less than 15 dBi), and the frequency band of this antenna makes it an ideal candidate for the air-to-air multifunction radar of the 90's. A prototype antenna is described and some X band results are given. M.G.

N87-18752# AEG-Telefunken, Ulm (West Germany). Radio and Radar Systems Group.
EHF MULTIFUNCTION PHASED ARRAY ANTENNA Abstract Only
Klaus Solbach *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The design of a low cost demonstration EHF multifunction-phased array antenna is described. Both, the radiating elements and the phase-shifter circuits are realized on microstrip substrate material in order to allow photolithographic batch fabrication. Self-encapsulated beam-lead PIN-diodes are employed as the electronic switch elements to avoid expensive hermetic encapsulation of the semiconductors or complete circuits. A space-feed using a horn-radiator to illuminate the array from the front-side is found to be the simplest and most inexpensive feed. The phased array antenna thus operates as a reflect-array, the antenna elements employed in a dual role for the collection of energy from the feed-horn and for the re-radiation of the phase-shifted waves (in transmit-mode). The antenna is divided into modules containing the radiator/phase-shifter plate plus drive- and BITE-circuitry at the back. Both drive- and BITE-components use gate-array integrated circuits especially designed for the purpose. Several bus-systems are used to supply bias and logical data flows to the modules. The beam-steering unit utilizes several signal processors and high-speed discrete adder circuits to combine the pointing, frequency and beam-shape information from the radar system computer with the stored phase-shift codes for the array elements. Since space, weight and power consumption are prime considerations only the most advanced technology is used in the design of both the microwave and the digital/drive circuitry. Author

N87-18753# Technische Hogeschool, Delft (Netherlands). Dept. of Electrical Engineering.
BASIC CHARACTERISTICS OF FM-CW RADAR SYSTEMS
L. P. Ligthart, L. R. Nieuwkerk, and J. S. vanSinttruyen *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 11 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Due to rapid technological progress in real-time signal processing, FM-CW radar systems are expected to become a more serious competitor to pulse radar systems. This paper deals with basic radar principles such as modulating waveforms and ambiguity functions characteristics. Advantages and disadvantages of FM-CW radar systems are compared to pulse radar systems. The inherent signal processing used in FM-CW radar systems allows a flexible choice of system parameters. In this context aspects like sensitivity, range and velocity resolution are discussed. It is elucidated that the use of digital processors for signal processing (frequency determination, filtering, etc.) offers the possibility to exchange dedicated hardware solutions with software implementations. Attention is paid to equipment like the antennas, diplexer, transmitter and receiver, and to isolation problems between transmitter and receiver. Results of an experimental FM-CW research radar are shown. In addition, the future prospects of FM-CW radar, with the aerial and solid-state R.F. head-end integrated, are indicated. M.G.

N87-18754# Thomson-CSF, Malakoff (France). Division A. V. S.
RADAR DISPLAY. CONVERSION OF SCANNING: ERRORS AND CORRECTION TECHNIQUES [VISUALISATION RADAR. CONVERSION DE BALAYAGE: DEFAUTS ET TECHNIQUES DAMELIORATION]
Jean-Claude Baron *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 10 p In FRENCH (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Video radar information resulting from processing circuits is in polar coordinates. The presentation of this information on a screen requires a preliminary storage in a memory referred to as a radar map memory or image memory. In numerous cases, the organization of image memory in cartesian coordinates is interesting because it allows: (1) certain radar processing to be easily carried out; (2) carrier movement compensation; and (3) direct access for the presentation of the image in the television mode. The conversion of scanning, which allows the recording of video radar (presented in polar coordinates) in the memory in cartesian coordinates, can generate errors, the most prominent of which are the loss of radar information for near distances and images with black zones for very great distances. The techniques which permit the removal or correction of these errors are based on: a harmonization between radar parameters and those of the image memory; processing techniques at the level of memory points or at the level of image pixels; and techniques of filling-in through interpolation. M.G.

N87-18755# Thomson-CSF, Malakoff (France). Division A. V. S.
POSTINTEGRATION OF RADAR IMAGES Abstract Only [POSTINTEGRATION DIMAGES RADAR]
Daniel Garnier *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p In FRENCH (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

The integration of radar maps, obtained with airborne synthetic antenna radar, enhances the quality of the maps by augmenting the contrast of actual echoes with respect to background noise. The enhancement works especially well on the noise called granulation or speckle, which is characteristic of coherent radar. The integration of radar maps representing a single scene obtained in the course of successive scans, therefore at different angles and distances, requires precise compensation for vehicle movement. This compensation is analyzed for the case of echo storage in an XY memory architecture and a rho-theta architecture. Two types of filters are examined: (1) the RC type; and (2) the sliding average filter. The experimental results are presented and the pros and cons for each procedure are discussed. M.G.

N87-18756# AEG-Telefunken, Ulm (West Germany).
DUAL FREQUENCY MM-WAVE RADAR FOR ANTITANK HELICOPTER Abstract Only
F. X. Jehle and H. Meinel *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Helicopters are gaining increasing significance for air close support, airborne landing, tank unit interdiction and both helicopter and tank engagement missions. To support these mission phases, sensors are required for obstacle warning, navigation, and moving and fixed target indication for weapon designation. The majority of the present systems use optical and infrared sensors; some of them apply laser systems. These sensor systems are subject to considerable limitations with respect to their capability of penetrating bad weather zones, fog, and battlefield environment (dust, smoke, man-made fog etc.). The design concept of a dual-frequency radar operating in millimeter wave range which avoids these drawbacks and complements existing sensors is presented. It consists of a 60 GHz radar subsystem for obstacle warning including the detection of wires up to a range of approximately 500 m; due to the selection of a frequency in the absorption line of oxygen resulting in a high atmospheric attenuation (16 dB/km), the susceptibility to interception and thus also to interference electronic countermeasures can be maintained at a very low level. A 50 GHz radar subsystem (attenuation as low as 0.3 dB/km) with its range of approximately 5 km against targets of interest is used for navigation, fixed and moving target indication as well as weapon designation. Due to the combination of the two subsystems (50/60 GHz), high-value components (antenna, scanner, receiver assemblies, control and indicator units) can be used jointly for both subsystems, so that the special features of each subsystem become available at reasonable expenses. Author

N87-18757# Alabama Univ., Huntsville. Dept. of Electrical and Computer Engineering.
SIMULATION OF MULTISTATIC AND BACKSCATTERING CROSS SECTIONS FOR AIRBORNE RADAR
Albert W. Biggs *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 11 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

In order to determine susceptibilities of airborne radar to electronic countermeasures and electronic counter-countermeasures simulations of multistatic and backscattering cross sections were developed as digital modules in the form of algorithms. Cross-section algorithms are described for prolate (cigar shape) and oblate (disk shape) spheroids. Backscattering cross section algorithms are also described for different categories of terrain. Backscattering cross section computer programs were written for terrain categorized as vegetation, sea ice, glacial ice, geological (rocks, sand, hills, etc.), oceans, man-made structures, and water bodies. PROGRAM SIGTERRA is a file for backscattering cross section modules of (TERRA) such as vegetation (AGCROP), oceans (OCEAN), Arctic sea ice (SEAICE), glacial snow (GLASNO), geological structures (GEOL), man-made structures (MANMAD), or water bodies WATER). AGCROP describes agricultural crops, trees or forests, prairies or grassland, and shrubs or bush cover. OCEAN has the SLAR or SAR looking downwind, upwind, and crosswind at the ocean surface. SEAICE looks at winter ice and old or polar ice. GLASNO is divided into a glacial ice and snow or snowfields. MANMAD includes buildings, houses, roads, railroad tracks, airfields and hangars, telephone and power lines, barges, trucks, trains, and automobiles. WATER has lakes, rivers, canals, and swamps. PROGRAM SIGAIR is a similar file for airborne targets such as prolate and oblate spheroids. Author

N87-18758# Department of Communications, Ottawa (Ontario).
THE USE OF SIMULATED SYNTHETIC-APERTURE RADAR: SIGNALS OF SHIPS IN THE DEVELOPMENT OF AN AUTOMATIC SHIP CLASSIFICATION SYSTEM Abstract Only
Malcolm R. Vane and J. K. E. Tunsley (London Research and Development, Ontario) *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

One of the major problems encountered in developing and testing any target classification scheme is the collection of an adequate data base for training and testing the classifier. This is particularly a problem if one must obtain radar information from a large number of viewing angles and over a large number of targets, some of which may be unfriendly. A method for obtaining this information by simulation is described. Synthetic aperture radar signals such as would be obtained from either a moving or a stationary ship, are simulated and it is shown how such a facility can be used in the development of an automatic ship classification system. The images of stationary ships are used to train and test the classification system and the images of moving vessels are used to show how the classifier performance degrades if the motion is left uncorrected. A readily available data base such as Jane's Book of Ships is used to compile 3-D outlines of the vessels of interest. These outlines, accurate down to the 1-m level, are used to decompose the ship's superstructure into a set of radar scatterers. The returns from the scatterers are then summed, taking into account the viewing angle of the radar. Using this technique,

the radar scattering models for a complete library of ships can be formed, and the library used to develop and test various automatic classification schemes. Examples of simulated SAR images of ships are given and the real image of a particular ship is compared to its simulated one. The limitations of the technique are discussed, and the use of the data in testing an actual classification scheme is briefly outlined. Author

N87-18759# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
REQUIREMENTS AND APPLICATIONS FOR RADAR SIMULATIONS: A STANDPOINT OF AN AIRFRAME COMPANY
Werner Kohl and Wolfgang Hetzner *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 13 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

An overview of requirements and applications for radar simulations performed by an airframe company is presented. The discussion covers offline computer models either as stand alone or implemented within air or sea combat simulations. The use for online models reach from interface simulations to rather complex models for manned aircraft simulations. The paper presents realized examples of radar models for air or sea combat simulations, an experimental engineering tool which simulates a core avionic system, a 1 versus 1 advanced flight simulation with a pilot in the loop and a radar signal simulation implemented in a terrain-following closed loop simulation at an avionic rig. Author

N87-18760# Thomson-CSF, Montrouge (France).
CRITERIA FOR THE EVALUATION OF RANGE PERFORMANCES IN AIR/AIR INTERCEPTION Abstract Only [CRITERES POUR LEVALUATION DES PERFORMANCES DE PORTEE EN INTERCEPTION AIR/AIR]
P. Ramstein *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p In FRENCH (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

Radar range performances are given either as a scanning detection probability of 50%, or a cumulative detection probability of from 85 to 90%, depending on the approach speed of the target and the duration of the scan cycle. These values offer only incomplete data for the evaluation of intercept performance. More complete data can be obtained by considering, for a given target, the acquisition probability, or better, probability of definite acquisition, that is, not following losses at great or moderate distance. A method of fast computation for these probabilities is described which avoids the use of statistical simulation. This method, based on the use of Markov chains, takes into account the logistics of acquisition and target loss, as well as the probability of detection in one pass. Examples are given which show how to optimize the scanning speed and permit a comparison of modes with and without transmission frequency agility. Finally, a discussion addressing the selection of evaluation criteria best adapted to a given operational situation is presented. M.G.

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N87-18761*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FREQUENCY DOMAIN LASER VELOCIMETER SIGNAL Patent Application
James F. Meyers, inventor (to NASA), John W. Stroughton, inventor (to NASA) (Old Dominion Univ., Norfolk, Va.), James I. Clemmons, Jr., inventor (to NASA), Sharad V. Kanetkar, inventor (to NASA), and Andreas E. Savakis, inventor (to NASA) Filed 24 Nov. 1986 23 p
(NASA-Case-LAR-13552-1-CU; NAS 1.71:LAR-13552-1-CU; US-Patent-Appl-SN-933941) Avail: NTIS HC A02/MF A01 CSCL 09C

The invention is a signal processor for measuring the oscillating frequency contained in a laser velocimeter signal burst or bursts. The input to the signal processor is applied through a fixed gain amplifier to an amplifier that has an automatic gain control provided by automatic gain circuit. The output from amplifier 14 is converted to digital by a non-linear analog-to-digital converter (ADC). The output from ADC 16 is shifted into two shift registers with a register receiving the most significant bits (MSB) from the ADC and with register receiving the least significant bits (LSB) from the ADC. A signal integration circuit under the control of the bits shifted into and out of the MSB shifter register determines when a signal burst has been captured by the shift registers. When a signal burst has been captured the data in the shift registers is transferred and processed by a bank of digital filters and other circuitry to determine the frequency in the signal burst. The automatic gain circuit is under the control of the bits shifted into and out of both shift registers. The novel feature of the invention appears to lie in the overall combination of the signal integration circuit, the automatic gain circuit with amplifiers, the ADC, the shift registers and the digital filter circuitry for processing captured signal bursts. Author

N87-18762*# Arizona State Univ., Tempe.
EDDY CURRENTS IN A CONDUCTING SPHERE
John Bergman and David Hestenes Oct. 1986 41 p Prepared for JPL
(Contract JPL-957562)
(NASA-CR-180236; JPL-9950-1269; NAS 1.26:180236) Avail: NTIS HC A03/MF A01 CSCL 09C

This report analyzes the eddy current induced in a solid conducting sphere by a sinusoidal current in a circular loop. Analytical expressions for the eddy currents are derived as a power series in the vectorial displacement of the center of the sphere from the axis of the loop. These are used for first order calculations of the power dissipated in the sphere and the force and torque exerted on the sphere by the electromagnetic field of the loop. Author

N87-18763# Office of Naval Research, London (England).
GALLIUM ARSENIDE INTEGRATED CIRCUITS AND TECHNOLOGY
M. L. Pengue 7 Nov. 1986 10 p
(AD-A174434; ONRL-R-7-86) Avail: NTIS HC A02/MF A01 CSCL 09/5

Key efforts in gallium arsenide integrated circuits and technology in the UK and France are reviewed. The review is based on visits to five organizations working in the field, and covers the developments they are pursuing and the potential they exhibit for turning the products of their research into practical processes or manufactured components. GRA

N87-18764# Naval Research Lab., Washington, D. C.
STAGED INDUCTIVE PULSE GENERATOR WITH CAPACITIVE CURRENT SOURCE
R. D. Ford, J. K. Burton, R. J. Commisso, G. Cooperstein, and J. M. Grossmann 24 Oct. 1986 23 p
(AD-A174720; NRL-MR-5852) Avail: NTIS HC A02/MF A01 CSCL 10/2

A pulse generator for testing fast opening, vacuum switches that uses vacuum inductive energy storage with an economical capacitor bank current source and copper-wire fuses for the first stage opening switch is now operational. Initial, low level tests with a self-closing output switch result in an output pulse current of 450 kA and risetime of 0.6 micron. GRA

N87-18765# Argonne National Lab., Ill. Chemical Technology Div.
EFFECTS OF OPERATING TEMPERATURE ON THE CHARAC-

TERISTICS OF NICKEL/IRON TRACTION BATTERIES
W. H. DeLuca, R. L. Biwer, and A. F. Tummillo Jul. 1986 25 p (Contract W-31109-eng-38)
(DE86-016029; ANL-86-6) Avail: NTIS HC A02/MF A01

Performance of improved Ni/Fe electric vehicle batteries was measured at ambient temperatures of 0, 25, and 50 C for a range of overcharge levels, open-circuit stand times, and charge and discharge rates. Tests in which charges and discharges were performed at different battery operating temperatures showed that the discharge capacity of a Ni/Fe battery is directly related to its operating temperature, but its charge acceptance is descreased at 0 and 50 C by approx. 5% from that obtained at 25 C. The decline in battery efficiency at high temperatures is the result of increased self-discharge losses. In the first 0.5 h after charge, the Ah self-discharge loss at 50 C is twice (6%) that at 0 and 25 C (approx. 3%), corresponding to an increase in initial self-discharge rate from approx. 8 to 16 A. The increased self-discharge rate apparently occurs during the latter part of charging and, thereby, causes the 6% decline in charge acceptance. A decrease in battery efficiency also resulted at 50 C (6% coulombic and 4% energy efficiency loss) when the charge current was reduced from the 3-h to the 6-h rate. In comparison, low temperatures impact battery internal resistance and IR-free voltage more than high temperatures. For an increase in ambient temperature from 25 to 50 C, battery IR-free voltage increased less than 1% and battery resistance decreased only 3%. However, a decrease from 25 to 0 C resulted in a 2.3% decrease in IR-free voltage and about a 22% increase in resistance. The available capacity and operating efficiency of a Ni/Fe battery are maximal near 25 C. To maintain the same Ah capacity achieved at 25 C with a 20% overcharge, the overcharge must be doubled at 50 C (42%) and tripled at 0 C (60%). Test procedures and equipment are described, test data are presented, and results are discussed. DOE

N87-18766# Sandia National Labs., Albuquerque, N. Mex.
BETA'-ALUMINA ELECTROLYTE FAILURE IN SODIUM/SULFUR BATTERIES
E. K. Beauchamp Jul. 1986 14 p
(Contract DE-AC04-76DP-00789)
(DE86-013634; SAND-86-0019) Avail: NTIS HC A02/MF A01

Several beta-alumina electrolyte tubes have been extracted from sodium/sulfur cells after in-service failure of the cells. Fractographic examination of the tube fragments has resulted in the identification of two previously unrecognized modes of tube failure in which the cell cathode material generates large stresses that result in fracture of the tube. Generally, the origins of the fractures were internal defects in the tube. Most of the defects were voids with diameters of 50 to 300 mm often in combination with large (50 to 250 mm) beta-alumina grains. The size of these defects indicates that stresses were approx. 70 MPa at failure. DOE

N87-18767# Sandia National Labs., Albuquerque, N. Mex. Pulsed Power Theory Div.
ELECTRICAL RESISTIVITY MODEL OF METALS
T. J. Burgess 1986 11 p Presented at the 4th International Conference on Megagauss Magnetic-Field Generation and Related Topics, Santa Fe, N. Mex., 14 Jul. 1986
(Contract DE-AC04-76DP-00789)
(DE86-014298; SAND-86-1093C; CONF-860703-28) Avail: NTIS HC A02/MF A01

A multi-phase electrical resistivity model of the metals copper, silver, gold, tungsten, aluminum, and stainless steel is described. Particular attention is devoted to the behavior at melt. DOE

N87-18768# Stanford Linear Accelerator Center, Calif.
IMPROVING THE EFFICIENCY OF MICROWAVE DEVICES WITH A DOUBLE OUTPUT CAVITY
K. R. Eppley, W. B. Herrmannsfeldt, and T. G. Lee May 1986 4 p Presented at the Linear Accelerator Conference, Stanford, Calif., 2 Jun. 1986
(Contract DE-AC03-76SF-00515)
(DE86-015810; SLAC-PUB-3984; CONF-860629-53) Avail: NTIS HC A02/MF A01

Double output cavities have been used experimentally to increase the efficiency of high-power klystrons. We have used particle-in-cell simulations with the 2 + 1/2 dimensional code MASK to optimize the design of double output cavities for the lasertron and the 50 MW klystron under development at SLAC. We discuss design considerations for double output cavities (e.g., optimum choice of voltages and phases, efficiency, wall interception, breakdown). We describe how one calculates the cavity impedance matrix from the gap voltages and phases. Simulation results are compared to experience with the 150 MW klystron. DOE

N87-18769# Argonne National Lab., Ill.
POWER PERFORMANCE OF LIAlSi/(FeNi)S CELLS
L. Redey 1986 8 p Presented at the International Workshop on High Temperature Molten Salt Batteries, Argonne, Ill., 16 Apr. 1986
(Contract W-31-109-eng-38)
(DE87-001577; CONF-8604116-8) Avail: NTIS HC A02/MF A01

Half-cell and model-cell experiments have been conducted to investigate the electrochemical performance of (Fe-Ni)S2 electrodes and Li-Al-Si/(Fe-Ni)S2 cells. The electrodes, fabricated with 0.5- to 2-Ah theoretical capacity, have been investigated in both LiCl-LiBr-KBr and LiF-LiCL-LiBr electrolyte in the temperature ranges of 320 to 500 C and 450 to 500 C, respectively. Nickel-sulfide additive was found to improve the kinetics of the FeS2 electrode. Power performance and charge acceptance of the cell improves to a great extent when Li2S is used in excess of the stoichiometric amount required by the metal sulfide formation. The presence of lithium sulfide at the end of charge provides a unique overcharge protection mechanism. DOE

N87-18770# Argonne National Lab., Ill.
REFERENCE-ELECTRODE SYSTEMS AND THEIR APPLICATION IN LI/MS/SUB x/ BATTERY RESEARCH
L. Redey 1986 10 p Presented at the International Workshop on High Temperature Molten Salt Batteries, Argonne, Ill., 16 Apr. 1986
(Contract W-31-109-eng-38)
(DE87-001579; CONF-8604116-9) Avail: NTIS HC A02/MF A01

Three reference electrode systems, Li-Al vertical bar Li(+), Ni vertical bar Ni3S2 vertical bar S2 (-), and Ag vertical bar Ag(+), are described briefly and evaluated on the basis of experience gained during about 200,000 test hours. The Li-Al vertical bar Li(+) system has been selected as the primary standard because of the convenience of in situ calibration and the availability of a technique that unmistakably manifests the standard condition of the electrode. The Ni vertical bar Ni3S2 reference electrode is extremely stable, with slow potential shift of no more than + or - 2 to 3 mV during thousands of hours of operation. The short-range stability (less than 100 hours) is + or - 0.1 mV. Advantages of the Ag vertical bar Ag(+) membrane electrode system are the perfect chemical isolation from the rest of the cell and the possibility of miniaturization by means of 0.5- to 1.0-mm-OD Pyrex capillaries. DOE

N87-18771# Public Service Electric and Gas Co., Newark, N. J.
BATTERY ENERGY STORAGE TEST (BEST) FACILITY SUMMARY REPORT 1976-1986
Oct. 1986 40 p
(Contract DE-AC02-76ET-29368)
(DE87-001611; DOE/ET-29368/H1) Avail: NTIS HC A03/MF A01

The objective of the Battery Energy Storage Test (BEST) Facility program is the testing and evaluation of battery energy storage systems in a utility environment. Highlights are given for the major accomplishments of the BEST Facilty program from March 1976 through August 1986. The design, construction, and acceptance testing of the facility are briefly described. Emphasis is given to a summmary of operation. Tests were completed of a 1.8 MWh calcium grid, lead-acid battery system, a developmental 500 kWh zinc chloride battery system, and a 500 kWh lead-acid, peaking battery system. Tests included cycling in operations typical

of utility and customer-side-of-the-meter applications. The power conversion and power quality at the BEST Facility are discussed, followed by consideration of future concerns for battery energy storage. DOE

N87-18772# Institut National Polytechnique, Grenoble (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
BINARY SEQUENCE GENERATOR: 900 MHz PSK PSEUDORANDOM MODULATOR [GENERATEUR DE SEQUENCE BINAIRE PSEUDO-ALEATOIRE MODULATEUR PSK 900 MHz]
D. Mathieu and G. Revol 30 Apr. 1986 28 p In FRENCH
(CEPHAG-20/86; ETN-87-99034) Avail: NTIS HC A03/MF A01

A wide band signal generator characterized by the binary modulation of a PSK carrier is described. The modulation indicator is a maximum length binary sequence obtained in a loop including a shift register and a module two adder. The good time resolution obtained allows the separation of multiple path transmissions. The particular form of the autocorrelation function allows the assimilation to a white noise, resulting in possible applications including signal detection, synchronization, and transfer function determination. ESA

N87-18773# National Bureau of Standards, Gaithersburg, Md. Center for Electronics and Electrical Engineering.
CENTER FOR ELECTRONICS AND ELECTRICAL ENGINEERING TECHNICAL PUBLICATION ANNOUNCEMENTS COVERING CENTER PROGRAMS, OCTOBER TO DECEMBER 1985 WITH 1986 CEEE EVENTS CALENDAR
E. J. Walters Jul. 1986 28 p
(PB86-247608; NBSIR-86-3424) Avail: NTIS HC A03/MF A01 CSCL 09C

This is the seventh issue of a quarterly publication providing information on the technical work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the Center for Electronics and Electrical Engineering Technical Publication Announcements covers the fourth quarter of calendar year 1985. Abstracts are provided by technical areas for papers published this quarter. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N87-18774 British Library Lending Div., Boston Spa (England).
ENGINEERING METHOD OF CALCULATING MASSIVE BODIES IN CONDITIONS OF RADIANT HEAT TRANSFER
V. I. Timoshpolskii [1987] 7 p Transl. into ENGLISH from Izvestiya Vusshikh Uchebnykh Zavedenii, Chernaya Metallurgiya (USSR), no. 7, 1986 p 126-129
(BLL-M-37064-(5828.4)) Avail: British Library Lending Div., Boston Spa, Engl.

Analytical-numerical expressions for calculation of heat propagation in thermally massive bodies in inertial and regular stages are examined. Cases of radiative and convective heating are analyzed using the equivalent sources method together with the scheme of the thermal layer adopted in heating theory. Author

N87-18775 British Library Lending Div., Boston Spa (England).
DETERMINING THE DIAMETER OF THE VACUUM ZONE IN A LOW PRESSURE VORTEX INJECTOR
V. V. Sterligov and S. G. Korotkov [1987] 8 p Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedenii (USSR), no. 8, 1986 p 118-121
(BLL-M-37103-(5828.4)) Avail: British Library Lending Div., Boston Spa, Engl.

The design of a low pressure vortex injector is considered, and how the geometrical parameters of the injector govern the diameter of the vacuum region at the axis of the flow of gas is discussed. This diameter governs the injecting power of the device. Empirical equations are given for calculating the vacuum zone. Author

N87-18776 British Library Lending Div., Boston Spa (England).
INTERACTION BETWEEN A CONCENTRATED FLOW OF GAS AND A DENSE LAYER OF FREE FLOWING SUBSTANCE
E. V. Maksimov, M. K. Alzhanov, B. S. Fialkov, and A. B. Talzhanov [1987] 8 p Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedenii, Chernaya Metallurgiya (USSR), no. 8, 1986 p 111-114
(BLL-M-37101-(5828.4)) Avail: British Library Lending Div., Boston Spa, Engl.

How a jet of gas forms a circulation zone in a layer of densely packed materials is considered. Equations are derived which show that there is an inverse relationship between the acceleration of the flow of gas and the amount of movement by the gas. Continuous and pulsating jets of gas are considered. When the region around the tuyere is pulverized the circulation zone does not take so long to form, and it has been found that pulsed injection of the gas is better than its continuous supply. Author

N87-18777*# Massachusetts Univ., Amherst.
STRUCTURE PARAMETERS IN ROTATING COUETTE-POISEUILLE CHANNEL FLOW
George H. Knightly and D. Sather (Colorado Univ., Boulder) [1986] 25 p
(Grants NAG2-278; N00014-85-K-0743)
(NASA-CR-179861; NAS 1.26:179861) Avail: NTIS HC A02/MF A01 CSCL 20D

It is well-known that a number of steady state problems in fluid mechanics involving systems of nonlinear partial differential equations can be reduced to the problem of solving a single operator equation of the form: v + lambda Av + lambda B(v) = 0, v is the summation of H, lambda is the summation of one-dimensional Euclid space, where H is an appropriate (real or complex) Hilbert space. Here lambda is a typical load parameter, e.g., the Reynolds number, A is a linear operator, and B is a quadratic operator generated by a bilinear form. In this setting many bifurcation and stability results for problems were obtained. A rotating Couette-Poiseuille channel flow was studied, and it showed that, in general, the superposition of a Poiseuille flow on a rotating Couette channel flow is destabilizing. B.G.

N87-18778*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THIN-ELEMENT RIBLET SURFACE Patent Application
Stephen P. Wilkinson, inventor (to NASA) Filed 21 Oct. 1986 13 p
(NASA-Case-LAR-13553-1; NAS 1.71:LAR-13553-1; US-Patent-Appl-SN-921575) Avail: NTIS HC A02/MF A01 CSCL 20D

The thin-element riblet surface of this invention is a modification of the traditional smooth flow surfaces used in aerodynamic or hydrodynamic applications. This modification is made by adding an array of very thin elements projecting from an otherwise smooth, impervious surface and forming small, adjacent, rectangular channels on the surface which are aligned with the flow. When the riblets are closely spaced, the normal process of turbulence production takes place above the peaks of the riblets. When the riblets are widely spaced, vortices form within the channels in pairs with opposite rotations at each riblet. The vortex rotation is such that turbulence production is localized above the vortices. In either case, the area immediately above the surface remains relatively quiet. NASA

N87-18779*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
HIGH EFFECTIVENESS CONTOUR MATCHING CONTACT HEAT EXCHANGER Patent Application
Robert L. Blakely, inventor (to NASA), George J. Roebelen, Jr., inventor (to NASA), and Arthur K. Davenport, inventor (to NASA)

Filed 19 Dec. 1986 11 p
(NASA-Case-MSC-20840-1; NAS 1.71:MSC-20840-1; US-Patent-Appl-SN-943346) Avail: NTIS HC A02/MF A01 CSCL 20D

There is a need in the art for a heat exchanger design having a flexible core which provides contour matching capabilities, which compensates for manufacturing tolerance and distortion buildups, and which accordingly furnishes a relatively uniform thermal contact conductance between the core and external heat sources under essentially all operating conditions. The core of the heat exchanger comprises a top plate and a bottom plate, each having alternating rows of pins attached thereto. Each of the pins fits into corresponding tight-fitting recesses in the opposite plate. Thus, the pin and recess design allows the heat exchanger core to expand the contract to match the mating part contours without significantly affecting the flow distribution, since gaps of varying thickness are not created at the ends of pins by the thermal expansion and contraction of the plates. Novelty resides in the use of recesses for one end of the pins to maintain the pins in thermal contact with both plates despite the nonuniform distance between the plates. NASA

N87-18780*# LTV Aerospace and Defense Co., Dallas, Tex. Missiles and Electronics Group.
ALTERNATE HIGH CAPACITY HEAT PIPE Final Report
F. E. Voss 31 Oct. 1986 168 p
(Contract NAS9-17327)
(NASA-CR-171970; NAS 1.26:171970; Rept-3-14000/6R-45) Avail: NTIS HC A08/MF A01 CSCL 20D

The performance predictions for a fifty foot heat pipe (4 foot evaporator - 46 foot condensor) are discussed. These performance predictions are supported by experimental data for a four foot heat pipe. Both heat pipes have evaporators with axial groove wick structures and condensers with powder metal external artery wick structures. The predicted performance of a rectangular axial groove/external artery heat pipe operating in space is given. Heat transport versus groove width is plotted for 100, 200 and 300 grooves in the evaporator. The curves show that maximum power is achieved for groove widths from 0.040 to 0.053 as the number of grooves varies from 300 to 100. The corresponding range of maximum power is 3150 to 2400 watts. The relationships between groove width and heat pipe evaporate diameter for 100, 200 and 300 grooves in the evaporator are given. A four foot heat pipe having a three foot condenser and one foot evaporator was built and tested. The evaporator wick structure used axial grooves with rectangular cross sections, and the condenser wick structure used powder metal with an external artery configuration. Fabrication drawings are enclosed. The predicted and measured performance for this heat pipe is shown. The agreement between predicted and measured performance is good and therefore substantiates the predicted performance for a fifty foot heat pipe. Author

N87-18781*# Universities Space Research Association, Huntsville, Ala. Systems Dynamics Lab.
A CRITICAL EVALUATION OF VARIOUS METHODS FOR THE ANALYSIS OF FLOW-SOLID INTERACTION IN A NEST OF THIN CYLINDERS SUBJECTED TO CROSS FLOWS Interim Report
Sang-Wook Kim Jan. 1987 76 p
(Contract NAS8-35918)
(NASA-CR-178996; NAS 1.26:178996) Avail: NTIS HC A05/MF A01 CSCL 20D

Various experimental, analytical, and numerical analysis methods for flow-solid interaction of a nest of cylinders subjected to cross flows are reviewed. A nest of cylinders subjected to cross flows can be found in numerous engineering applications including the Space Shuttle Maine Engine-Main Injector Assembly (SSME-MIA) and nuclear reactor heat exchangers. Despite its extreme importance in engineering applications, understanding of the flow-solid interaction process is quite limited and design of the tube banks are mostly dependent on experiments and/or experimental correlation equations. For future development of major numerical analysis methods for the flow-solid interaction of a nest of cylinders subjected to cross flow, various turbulence models, nonlinear structural dynamics, and existing laminar flow-solid interaction analysis methods are included. Author

N87-18782*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AEROTHERMAL EVALUATION OF A SPHERICALLY BLUNTED BODY WITH A TRAPEZOIDAL CROSS SECTION IN THE LANGLEY 8-FOOT HIGH-TEMPERATURE TUNNEL
Cindy W. Albertson Apr. 1987 83 p
(NASA-TP-2641; L-16096; NAS 1.60:2641) Avail: NTIS HC A05/MF A01 CSCL 20D

A model to be used in the flow studies and curved Thermal Protection System (TPS) evaluations was tested in the Langley 8 Foot High-Temperature Tunnel at a nominal Mach number of 6.8. The purpose of the study was to define the surface pressure and heating rates at high angles of attack (in support of curved metallic TPS studies) and to determine the conditions for which the model would be suitable as a test bed for aerothermal load studies. The present study was conducted at a nominal total temperature of 2400 and 3300 R, dynamic pressures from 2.3 to 10.9 psia, and free-stream Reynolds numbers from 4000,000 to 1,700,000/ft. The measurements consisted primarily of surface pressure and cold-wall (530 R) heating rates. Qualitative comparisons between predictions and data show that for this configuration, aerothermal tests should be limited to angles of attack between 10 and -10 degrees. Outside this range, the effects of free-stream flow nonuniformity appear in the data, as a result of the long length of the model. However, for TPS testing, this is not a concern and tests can be performed at angles of attack ranging from 20 to -20 degrees. Laminar and naturally turbulent boundary layers are available over limited ranges of conditions. Author

N87-18783*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A SECOND-ORDER ACCURATE KINETIC-THEORY-BASED METHOD FOR INVISCID COMPRESSIBLE FLOWS
Suresh M. Deshpande Dec. 1986 42 p
(NASA-TP-2613; L-16050; NAS 1.60:2613) Avail: NTIS HC A03/MF A01 CSCL 20D

An upwind method for the numerical solution of the Euler equations is presented. This method, called the kinetic numerical method (KNM), is based on the fact that the Euler equations are moments of the Boltzmann equation of the kinetic theory of gases when the distribution function is Maxwellian. The KNM consists of two phases, the convection phase and the collision phase. The method is unconditionally stable and explicit. It is highly vectorizable and can be easily made total variation diminishing for the distribution function by a suitable choice of the interpolation strategy. The method is applied to a one-dimensional shock-propagation problem and to a two-dimensional shock-reflection problem. Author

N87-18784*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMOMECHANICAL BEHAVIOR OF PLASMA-SPRAYED ZrO2-Y2O3 COATINGS INFLUENCED BY PLASTICITY, CREEP AND OXIDATION
J. Padovan (Akron Univ., Ohio), B. T. F. Chung, Glen E. McDonald, and Robert C. Hendricks 1987 15 p Presented at the 11th Annual Conference on Composites, Advanced Ceramics and Composite Materials, Cocoa Beach, Fla., 18-23 Jan. 1987; sponsored by NASA, DOD and the American Ceramic Society
(NASA-TM-88940; E-3385; NAS 1.15:88940) Avail: NTIS HC A02/MF A01 CSCL 20D

Thermocycling of ceramic-coated turbomachine components produces high thermomechanical stresses that are mitigated by plasticity and creep but aggravated by oxidation, with residual stresses exacerbated by all three. These residual stresses, coupled with the thermocyclic loading, lead to high compressive stresses that cause the coating to spall. A ceramic-coated gas path seal is modeled with consideration given to creep, plasticity, and oxidation.

The resulting stresses and possible failure modes are discussed. Author

N87-18785*# Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.
ADVANCED RADIATOR CONCEPTS UTILIZING HONEYCOMB PANEL HEAT PIPES (STAINLESS STEEL) Interim Technical Report
G. L. Fleischman and H. J. Tanzer Aug. 1985 78 p
(Contract NAS9-16581)
(NASA-CR-171977; NAS 1.26:171977; W-30746) Avail: NTIS HC A05/MF A01 CSCL 20D

The feasibility of fabricating and processing moderate temperature range heat pipes in a low mass honeycomb sandwich panel configuration for highly efficient radiator fins for the NASA space station was investigated. A variety of honeycomb panel facesheet and core-ribbon wick concepts were evaluated within constraints dictated by existing manufacturing technology and equipment. Concepts evaluated include: type of material, material and panel thicknesses, wick type and manufacturability, liquid and vapor communication among honeycomb cells, and liquid flow return from condenser to evaporator facesheet areas. In addition, the overall performance of the honeycomb panel heat pipe was evaluated analytically. Author

N87-18786*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID SHEET RADIATOR
Donald L. Chubb and K. Alan White, III 1987 13 p Prepared for presentation at the 22nd Thermophysics Conference, Honolulu, Hawaii, 8-10 Jul. 1987; sponsored by AIAA
(NASA-TM-89841; E-3497; NAS 1.15:89841) Avail: NTIS HC A02/MF A01 CSCL 20D

A new external flow radiator concept, the liquid sheet radiator (LSR), is introduced. The LSR sheet flow is described and an expression for the length/width (l/w), ratio is presented. A linear dependence of l/w on velocity is predicted that agrees with experimental results. Specific power for the LSR is calculated and is found to be nearly the same as the specific power of a liquid droplet radiator, (LDR). Several sheet thicknesses and widths were experimentally investigated. In no case was the flow found to be unstable. Author

N87-18787# Oak Ridge National Lab., Tenn. Chemical Technology Div.
DETERMINATION OF HIGH-TEMPERATURE FLUID VISCOSITY USING DYNAMIC LIGHT SCATTERING Ph.D. Thesis
D. F. Williams, C. H. Byers, and J. S. Watson Aug. 1986 99 p
(Contract DE-AC05-84OR-21400)
(DE86-015972; ORNL/TM-9648) Avail: NTIS HC A05/MF A01

A light-scattering method for measurement of high-temperature viscosities was developed in this study. Dynamic light scattering was used to measure viscosity by characterizing the effect of fluid drag on the motion of suspended microparticles. The critical experimental factors were identified and analyzed. Stabilization of the model microparticles against aggregation was found to be of prime importance, and this topic is discussed in detail. Selected predictive correlations for viscosity were also examined and evaluated. DOE

N87-18788# Oak Ridge National Lab., Tenn.
DESIGN OF TUBE-IN-SHELL HEAT EXCHANGERS FOR He-2
L. Dresner 1986 13 p Presented at the 6th Intersociety Cryogenics Symposium, Miami Beach, Fla., 2 Nov. 1986
(Contract DE-AC05-84OR-21400)
(DE86-008891; CONF-861131-1) Avail: NTIS HC A02/MF A01

In a tube-in-shell heat exchanger, hot fluid flows through a bank of parallel tubes immersed in a constantly renewed cold bath. As the hot fluid advances through the tubes, it cools. We would like to determine its temperature as a function of the distance it has traveled. In some fluids (e.g., water) longitudinal heat conduction can be neglected compared with longitudinal convection. But in helium-2, it cannot. Here, it refers not to ordinary heat conduction, but to heat conduction by the vastly more powerful Gorter-Mellink counterflow. So the temperature distribution in the tubes is determined by the interplay of longitudinal convection, longitudinal Gorter-Mellink counterflow, and transverse heat transport through the walls. DOE

N87-18789# Los Alamos National Lab., N. Mex.
EQUIVALENT ONE-DIMENSIONAL COEFFICIENT FOR HYDRODYNAMIC DISPERSION IN A CIRCULAR TUBE
I. Partom Sep. 1986 16 p
(Contract W-7405-eng-36)
(DE87-000793; LA-10822-MS) Avail: NTIS HC A02/MF A01

The problem of hydrodynamic dispersion in a circular tube is solved numerically. From the solution breakthrough curves of various distances from the inflow end and for different flow velocities are obtained. From these breakthrough curves the equivalent one-dimensional dispersion coefficient (Deq) is computed in the same way this is done in experimental work. Deq is a function of the longitudinal Peclet number (Pe(sub L)) and for large Pe(sub L) Deq is proportional to Pe(sub L). This is unlike the well-known Taylor solution, and it agrees much better with experimental results. The differences between this solution and Taylor's is also discussed. DOE

N87-18790# Lawrence Livermore National Lab., Calif.
FLOW OF GRANULAR SOLIDS: 3-DIMENSIONAL, DISCRETE-PARTICLE COMPUTER MODELING OF UNIFORM SHEAR
O. R. Walton, R. L. Braun, and D. M. Cervelli 1986 16 p Presented at the Joint PETC/METC Direct Utilization AR and TD Contractors Review Meeting, Warrendale, Pa., 22 Sep. 1986
(Contract W-7405-eng-48)
(DE87-001366; UCRL-95232; CONF-8609154-2) Avail: NTIS HC A02/MF A01

The objective of this research is to develop an understanding for, and an ability to predict, the flow behavior of granular solids. In FY86 a major aim was to extend a successful two-dimensional computer models to three-dimensions and to utilize these new models to study the rheology of assemblies of inelastic, frictional spheres in steady shearing flow. DOE

N87-18791# Lawrence Livermore National Lab., Calif.
CONSTITUTIVE MODEL USED IN COMPUTER SIMULATION OF TIME-RESOLVED, SHOCK-WAVE DATA
D. J. Steinberg Oct. 1986 11 p Presented at the Hypervelocity Impact Symposium, San Antonio, Tex., 21 Oct. 1986
(Contract W-7405-eng-48)
(DE87-000972; UCRL-93703; CONF-861091-9) Avail: NTIS HC A02/MF A01

A constitutive model was designed for use with high-speed, hydrodynamic computer codes. The model, valid at high-deformation rates, accounts for pressure and temperature dependence of the yield strength and shear modulus, work hardening, pressure-dependent melting, Bauschinger and strain-rate effects, and spall. There are a minimum number of parameters needed to implement the model, and most can be determined without recourse to shock-wave data. At Lawrence Livermore National Laboratory, we assembled a library of these material properties for 44 metals, alloys, mixtures, and compounds. Shock and release data from plate-impact experiments for Be, U, Ta, Cu, 1100-0, and 6061-T6 al, with peak stresses from 6.4 to 230 GPa, are successfully compared against calculations. DOE

N87-18792# Lawrence Livermore National Lab., Calif.
THE RESPONSE OF A TURBULENT BOUNDARY LAYER TO A SMALL-AMPLITUDE TRAVELING WAVE
F. A. Howes Dec. 1986 8 p
(Contract W-7405-eng-48)
(DE87-003609; UCID-20938) Avail: NTIS HC A02/MF A01

We study the response of a turbulent boundary layer to an outer-flow disturbance in the form of a small-amplitude wave travelling along the bottom of a smooth channel. In a previous paper we proposed a model for the viscous attenuation of a wave propagating along the interface between two superposed

fluids inside a laminar boundary layer attached to the bottom wall. We obtained precise estimates on the amount of attenuation suffered by the oscillatory component of the motion as a result of viscous dissipation. This was accomplished by means of a representation of the solution as the asymptotic sum of a Blasius boundary layer profile and a modified Stokes layer profile. The present paper contains a similar asymptotic decomposition of the solution of the appropriate turbulent Prandtl equations when the outer flow is a small-amplitude travelling wave, and so it may be considered an extension of our previous work to the more realistic case of turbulent flow. DOE

N87-18793# Cornell Univ., Ithaca, N.Y. Dept. of Physics.
SYSTEMS NEAR THE ONSET AND IN THE WELL-DEVELOPED REGIMES OF TURBULENCE: RESEARCH COMPLETED AND IN PROGRESS
E. Siggia 17 Dec. 1986 12 p
(Contract DE-AC02-83ER-13044)
(DE87-003708; DOE/ER-13044/6) Avail: NTIS HC A02/MF A01

Brief summaries of research by E. Siggia, M. J. Feigenbaum, and L. Chayes are presented. The research of E. Siggia concerns the study of singular solutions to the Biot-Savart model for a vortex filament, integrability for discrete Hamiltonian systems, and small divisor problems. M. J. Feigenbaum is studying the behavior of objects with highly complicated scaling properties. L. Chayes has focused on the mathematics and physics of disordered systems. Lists of publications for each researcher are included. DOE

N87-18794# Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.
FLUID MOTIONS GENERATED BY THE INJECTION OF AN ELECTRIC CURRENT Thesis
A. J. M. Jansen Aug. 1986 259 p
(LR-492; ETN-87-99149) Avail: NTIS HC A12/MF A01

Fluid motions induced by a Lorentz force due to the injection of an electric current and its associated magnetic field are studied. The semi-infinite point electrode configuration, also called the prototype model, and the semi-infinite disk electrode configuration are analyzed. The analysis shows that the behavior of the fluid motion in the neighborhood of an electrode of finite size is regular. At large radial distance from the electrode and in the prototype model, the usual similarity method is not applicable for larger values of the hydrodynamic Reynolds number. The derivation of the general inviscid and viscous solutions clarifies the inconsistencies appearing in the far field. ESA

N87-18795# Technische Hochschule, Darmstadt (West Germany). Fachbereich Maschinenbau.
CALCULATION OF THE PRESSURE DROP OF TWO-PHASE FLOWS USING THE FLOW MODEL OF WITTE IN HORIZONTAL AND VERTICAL PIPES Ph.D. Thesis [BERECHNUNG DES DRUCKVERLUSTES VON ZWEIPHASEN-STROEMUNGEN MIT HILFE DE STROEMUNGSMODELLS VON WITTE IN WAAGERECHTEN UND SENKRECHTEN ROHREN]
Abdelaziz Aly 1984 119 p In GERMAN Sponsored by the Arab Republic of Egypt
(ETN-87-99011) Avail: NTIS HC A06/MF A01

A method for the calculation of the pressure drop in water-vapor and fluid-gas mixtures was developed starting from the flow model of Witte. This model only allows the result to be obtained using an extensive iteration process. Mathematical approximation functions were developed which, via an extensive parameter variation, deduce an approximation with which the coefficient of friction can be calculated directly from the given parameters. ESA

N87-18796# Centre d'Etudes Aerodynamiques et Thermiques, Poitiers (France). Lab. d'Etudes Aerodynamiques.
INTEGRATION OF NAVIER]STOKES EQUATIONS BY A PSEUDO-SPECTRAL METHOD WITH DOMAIN TRANSFORMATION Final Report [INTEGRATION DES EQUATIONS DE NAVIER-STOKES PAR METHODE PSEUDO SPECTRALE AVEC TRANSFORMATION DE DOMAINE]
A. Farcy and Alziary deRoquefort Jun. 1986 48 p In FRENCH
(Contract DRET-84-057)
(ETN-87-99046) Avail: NTIS HC A03/MF A01

An algorithm for the Helmholtz equation with domain transformation is presented. Discretization is achieved by developing Chebyshev polynomials in truncated series. A linear transport-diffusion problem of a scalar field is solved using an integration scheme in stable time treating the convective and diffusive terms implicitly. A superposition method for calculating the pressure in the incompressible Navier-Stokes equation is outlined. Results for Green-Taylor vortices, an entrained polar cavity, and a two dimensional channel of variable profile are given. ESA

N87-18797# Institut National de Recherche d'Informatique et d'Automatique, Rocquencourt (France).
NUMERICAL SIMULATION BY FINITE ELEMENT METHODS OF TRANSONIC UNSTEADY FLOW OF COMPRESSIBLE VISCOUS FLUIDS MODELED BY THE NAVIER-STOKES EQUATIONS [SIMULATION NUMERIQUE PAR DES METHODES D'ELEMENTS FINIS D'ECOULEMENTS TRANSSONIQUES INSTATIONNAIRES DE FLUIDES VISQUEUX COMPRESSIBLES MODELISES PAR LES EQUATIONS DE NAVIER-STOKES]
6 Nov. 1986 36 p In FRENCH
(Contract DRET-83-403)
(ETN-87-99048) Avail: NTIS HC A03/MF A01

A method which generalizes tools developed for solving the Navier-Stokes equations for incompressible fluids to viscous fluids is outlined. It covers the Stokes solver and the least squares method. A semi-implicit method for the total constant enthalpy model, and implicit scheme for the model with the temperature equation are emphasized. Applications to industrial flows are indicated. Two and three dimensional numerical results and simulations of the flow around an air intake are presented. ESA

N87-18798# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
FULL APPROXIMATIVE SCHEME (FAS) MULTIGRID EMPLOYING INCOMPLETE LOWER UPPER DECOMPOSITION/ STRONGLY IMPLICIT PROCEDURE (ILU/SIP) SMOOTHING: A ROBUST FAST SOLVER FOR 3D TRANSONIC POTENTIAL FLOW
A. J. vanderWees 29 Aug. 1985 21 p Presented at the 2nd European Conference on Multigrid Methods Sponsored by the Netherlands Agency for Aerospace Programs
(NLR-MP-85072-U; ETN-87-99292) Avail: NTIS HC A02/MF A01

The incomplete lower upper decomposition and strongly implicit procedure method is shown to be a very efficient and robust smoothing algorithm within the multigrid method for the solution of elliptic (subsonic) and mixed elliptic/hyperbolic (transonic) potential flow problems. The algorithm, the basis of the Multicomponent Aircraft Transonic Inviscid Computation System, is fully implicit and fairly insensitive to large grid cell aspect ratios; in the hyperbolic regions of the flow the algorithm is uniformly stable. It is shown that the best multigrid performance for 3D problems is obtained by performing a priori grid optimization, for which requirements are derived. With an optimized grid, the method is fast for engineering applications and the physical quantities of interest are determined with great efficiency. ESA

N87-18799# Brookhaven National Lab., Upton, N. Y. Advanced Reactor Safety Analysis Group.
IMPROVED MODELING AND NUMERICS TO SOLVE TWO-DIMENSIONAL ELLIPTIC FLUID FLOW AND HEAT TRANSFER PROBLEMS
B. C. Chan May 1986 65 p
(Contract DE-AC02-76CH-00016; Grant NRC FIN-A-3274)
(TI86-011790; NUREG/CR-3705; BNL-NUREG-51751) Avail: NTIS HC A04/MF A01

A basic, limited scope, fast-running computer model is presented for the solution of two-dimensional, transient, thermally-coupled fluid flow problems. This model is to be the module in the SSC (an LMFBR thermal-hydraulic systems code) for predicting complex flow behavior, as occurs in the upper plenum of the

loop-type design or in the sodium pool of the pool-type design. The nonlinear Navier-Stokes equations and the two-equation (two-variable) transport model of turbulence are reduced to a set of linear algebraic equations in an implicit finite difference scheme, based on the control volume approach. These equations are solved iteratively in a line-by-line procedure using the tri-diagonal matrix algorithm. The results of calculational examplers are shown in the computer-generated plots. Author

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N87-18800*# National Aeronautics and Space Administration, Washington, D.C.
A HIGH-TEMPERATURE HEAT SENSITIVE ELEMENT
M. Oguro Sep. 1986 9 p Transl. into ENGLISH of Japanese Patent no. 54-104599 (16 Aug. 1979) p 453-455 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88520; NAS 1.15:88520) Avail: NTIS HC A02/MF A01 CSCL 14B

This invention concerns the high-temperature heat sensitive element which is stable at high temperatures. A solid solution of the main component MgO-Al2O3-Cr2O3-Fe2O3 which contains spinel crystal structure is mixed with the secondary component ZrO2 at the mol ratio of 100 : 0.1 to 5.0 and sintered to prepare a high-temperature heat sensitive element. Author

N87-18801*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACCELERATION DISPLAY SYSTEM FOR AIRCRAFT ZERO-GRAVITY RESEARCH
Marc G. Millis Mar. 1987 22 p
(NASA-TM-87358; E-3117; NAS 1.15:87358) Avail: NTIS HC A02/MF A01 CSCL 01D

The features, design, calibration, and testing of Lewis Research Center's acceleration display system for aircraft zero-gravity research are described. Specific circuit schematics and system specifications are included as well as representative data traces from flown trajectories. Other observations learned from developing and using this system are mentioned where appropriate. The system, now a permanent part of the Lewis Learjet zero-gravity program, provides legible, concise, and necessary guidance information enabling pilots to routinely fly accurate zero-gravity trajectories. Regular use of this system resulted in improvements of the Learjet zero-gravity flight techniques, including a technique to minimize later accelerations. Lewis Gates Learjet trajectory data show that accelerations can be reliably sustained within 0.01 g for 5 consecutive seconds, within 0.02 g for 7 consecutive seconds, and within 0.04 g for up to 20 second. Lewis followed the past practices of acceleration measurement, yet focussed on the acceleration displays. Refinements based on flight experience included evolving the ranges, resolutions, and frequency responses to fit the pilot and the Learjet responses. Author

N87-18802# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MICROWAVE OPEN RESONATORS FOR GYROTRONS
J. J. Barroso and A. Montes Dec. 1986 8 p Submitted for publication
(INPE-4076-PRE/1028) Avail: NTIS HC A02/MF A01

Weakly irregular waveguides which, under appropriate conditions, can be considered as open resonators are studied. Through the analysis of a variety of resonators, the influence of the cavity geometry on the longitudinal electric field distribution is discussed, aiming toward optimum field profiles with associated high efficiency operation. Open resonators operating in the TE 021 mode are presented, which have been designed for a 35 GHz gyrotron under construction at INPE. Author

N87-18803# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
STRAIN GAGE SIGNAL INTERPRETATION Final Report, Jun. 1983 - Jul. 1985
R. B. Fost, V. C. Gallardo, and W. R. Stowell Feb. 1986 88 p
(Contract F33615-83-C-2334)
(AD-A174323; R85AEB440; AFWAL-TR-85-2098) Avail: NTIS HC A05/MF A01 CSCL 14/2

Strain gage signals from aeromechanical vibrations of rotor blades and vanes have been collected, examined, classified, and generalized in a taxonomic sense. A unified and rational system has been developed for the interpretation of strain gage signals in terms of certain characteristics amenable to computer programming. Included are specifications for both hardware and software. GRA

N87-18804# Naval Weapons Center, China Lake, Calif.
MINIMIZATION OF STREAK CAMERA ERRORS IN DETONATION STUDIES Final Report, Oct. 1985 - Aug. 1986
H. D. Mallory Aug. 1986 9 p
(AD-A174426; AD-E900637; NWC-TP-6758) Avail: NTIS HC A02/MF A01 CSCL 14/5

It is common knowledge in the detonation community that streak camera velocity traces should be near 45 degrees for best results. Yet, there seems to be no systematic explanation for that belief. In this report some derivations are presented to show that such belief is indeed grounded in fact. The Naval Weapons Center is particularly interested in the Los Alamos Wedge Test. This test has in fact shown itself to be important in understanding the complex phenomenon of sensitivity. The derivations presented are applicable to that test to record the time at which a building detonation wave undergoes the transition to its steady-state velocity. GRA

N87-18805# Stanford Univ., Calif. Lab. of Physics.
LOW-FREQUENCY ACOUSTIC MICROSCOPE Final Report
B. T. Khuri-Yakub May 1986 4 p
(Grant AF-AFOSR-0198-84)
(AD-A174460; GL-4051; AFOSR-86-1080TR) Avail: NTIS HC A02/MF A01 CSCL 14/2

Low-frequency acoustic microscopy has demonstrated a tremendous potential for the nondestructive evaluation of metals, composite materials, and structural ceramics. This proposal allowed us to build a new, improved instrument with which can make not only amplitude, but also phase, measurements. The addition of the phase measurement capability allows us to do two dimensional image processing to extract more information from our measurements than is presently done with amplitude only acoustic microscopes. Also, the addition of the phase measurement capability allows us to measure profiles of samples with great accuracies. GRA

N87-18806# Naval Air Development Center, Warminster, Pa.
OPTICAL MEMORY TECHNOLOGY REVIEW. VOLUME 1: PRESENTATION MATERIAL
Jun. 1986 276 p Review held in Gaithersburg, Md., 11-12 Jun. 1986
(AD-A175980) Avail: NTIS HC A13/MF A01 CSCL 20/6

The following reports were presented at a conference on optical memory technology which took place at Gaitherburg, Maryland, in June 1986: US High Technology Industry, Its Principles and Challenges...With an Emphasis on the Optical Digital Data Disk (OD3) Challenge; Storage Requirements and Applications; Status of 5.25-Inch Optical Digital Data Disk Technology; Interpretation of US Department of Defense Specifications for Device Designers; and Optical Memory System Study Presentation. GRA

N87-18807# Naval Air Development Center, Warminster, Pa.
OPTICAL MEMORY TECHNOLOGY REVIEW. VOLUME 2: PRESENTATION MATERIAL
Jun. 1986 141 p Review held in Gaithersburg, Md., 11-12 Jun. 1986
(AD-A175981) Avail: NTIS HC A07/MF A01 CSCL 20/6

The following reports were presented at a conference on optical memory technology which took place at Gaithersburg, Maryland, in June 1986: Optical Disk Study Overview; Portable Optical Memory Systems for Tactical Applications; Overview of DOD/NASA Large Optical Disk Systems Development; Digital Map Generation; and Overview of Magnetic Disk Technology. GRA

N87-18808# Naval Air Development Center, Warminster, Pa.
OPTICAL MEMORY TECHNOLOGY REVIEW. VOLUME 3: PRESENTATION MATERIAL
Jun. 1986 129 p Review held in Gaithersburg, Md., 11-12 Jun. 1986
(AD-A175982) Avail: NTIS HC A07/MF A01 CSCL 20/6

The following reports were presented at a conference on optical memory technology which took place at Gaithersburg, Maryland, in June 1986: Federal Interest, Requirements, and Plans For Optical Disk Technology...As Told To The Federal Council on Computer Storage Standards and Technology; Optical Memory Recording Concepts and Current Commercialization Trends; Overview of Optical Digital Data; Overview of the National Space Science Data Center Optical Disk System Integration; and Issues in Optical Disk Longevity and Approaches to Optical Disk Life Testing. GRA

N87-18809# Allied Bendix Aerospace, Kansas City, Mo.
SMALL STRAIN GAGE APPLICATIONS
E. G. Wenski Sep. 1986 12 p Presented at the Summer Annual Meeting of the Western Regional Strain Gage Committee, Albuquerque, N. Mex., 12 Aug. 1986
(Contract DE-AC04-76DP-00613)
(DE86-015848; BDX-613-3600; CONF-8608115-1) Avail: NTIS HC A02/MF A01

This paper will focus on three different strain gage applications and three different strain gage configurations. Actual pictures of the experimental set-up will be discussed along with the actual data and proposed changes that resulted from these stress analyses. DOE

N87-18810# Lawrence Livermore National Lab., Calif.
REMOTE MEASUREMENT OF PRESSURE IN SHOCK WAVE ENVIRONMENTS USING FIBER OPTIC SENSORS
G. R. Haugen 12 Nov. 1986 12 p
(Contract W-7405-eng-48)
(DE87-002930; UCID-20922) Avail: NTIS HC A02/MF A01

A remote optical sensor would have a laser at the monitoring station coupled to an optical fiber which carries its light to an optical material at the fiber tip which returns some of the light back to the other end of the fiber. Design considerations are discussed. A fiber optic system and a pressure sensor have been fabricated. It is proposed to develop an optical remote sensor of pressure and temperature with a rapid response. DOE

36 LASERS AND MASERS

Includes parametric amplifiers
For related information see also *76 Solid-State Physics.*

N87-18811# Johns Hopkins Univ., Baltimore, Md. Dept. of Chemistry.
THEORY OF LASER-INDUCED PHENOMENA ON CONVENTIONAL AND PHASE-CONJUGATED SURFACES
J. T. Lin, Xi-Yi Huang, and Thomas F. George Nov. 1986 37 p
(Contract N00014-86-K-0043)
(AD-A174464; UBUFFALO/DC/86/TR-18) Avail: NTIS HC A03/MF A01 CSCL 07/4

Laser induced processes on conventional and phase conjugated surfaces are investigated theoretically. Resonance fluorescence of two level atoms on smooth and rough surfaces are reviewed. The new phenomenon of a radiative dipole at a phase conjugated surface (PCS) is examined, where the lifetime of the dipole can virtually be infinite under certain conditions. PCS originates from the interference of two laser beams incident on an absorbing layer and is discussed in terms of a phenomenological model and a hydrodynamic theory, where laser-induced periodic structure and the PCS reflectivity are analyzed. Finally, practical applications of these new phenomena occurring on PCS are discussed. GRA

N87-18812# Materials Research Labs., Ascot Vale (Australia).
EXTERNAL NONLINEAR FOCUSING AND ITS APPLICATION TO ULTRAFAST OPTICAL POWER LIMITING
J. A. Hermann and S. R. Kennett Aug. 1986 27 p
(AD-A174684; MRL-R-1013) Avail: NTIS HC A03/MF A01 CSCL 20/5

A simple model for external self-focusing or defocusing of a laser beam by a thin nonlinear phase corrector has been explored by numerical computation and by mathematical analysis. Utilizing the mechanisms of nonlinear absorption and refraction, it is shown how passive and ultrafast power- or energy-limiting device can be constructed, with the ultimate aim of protecting optical or infrared equipment from excessive laser powers. GRA

N87-18813# Army Night Vision Lab., Fort Belvoir, Va.
PASSIVE Q-SWITCHING OF CO2 TEA LASER USING SULFUR HEXAFLUORIDE (SF6) Report, Apr. - Aug. 1986
Robert Pastel Oct. 1986 20 p
(AD-A174783; AMSEL-NV-TR-0056) Avail: NTIS HC A02/MF A01 CSCL 20/5

Passive Q-switching of CO2 TEA laser using sulfur hexafluoride (SF6) has been demonstrated at 10.2 micron. There is minimum loss of peak power, narrowing of the pulse, and elimination of the tail. Q-switching a 9.6 micron is not observed. Also discussed is the use of SF6 to frequency the laser to the strong gain lines of the 10.2 micron and 9.6 micron branch of the CO2 emission. Both theory and experimental results are given. GRA

N87-18814# Lawrence Livermore National Lab., Calif.
DAMAGE TO MULTILAYER MIRRORS IN A HOSTILE ENVIRONMENT
R. M. More, K. H. Warren, and Z. Zinamon 1986 7 p Presented at the 30th SPIE Technical Symposium on Optics and Optoelectronic Engineering, San Diego, Calif., 17 Aug. 1986
(Contract W-7405-eng-48)
(DE87-000603; UCRL-95407; CONF-860880-33) Avail: NTIS HC A02/MF A01

Development of laboratory X-ray lasers will require cavity components (mirrors, etc.) able to survive intense pulses of soft X-rays. In this paper we examine physical processes which are likely to limit the performance of layered synthetic microstructures and establish a theoretical damage limit approx 0.1 Joule/sq cm for Mo-Si composites. We also examine the suitability of our general computational tools (XSN, QEOS, TKN, LASNEX) for this unusual low-temperature application. DOE

N87-18815# Lawrence Livermore National Lab., Calif.
PROSPECTS FOR X-RAY LASER APPLICATIONS
J. Trebes Jun. 1986 22 p Presented at the International Colloquium on X-ray Lasers, Aussois, France, 14 Apr. 1986
(Contract W-7405-eng-48)
(DE87-003252; UCRL-95396; CONF-8604224-7) Avail: NTIS HC A02/MF A01

The prospects for the near term application of current X-ray lasers are examined. Four areas of application are discussed: (1) grating production, (2) photo-ionization laser physics, (3) contact microscopy, and (4) holography. Evolutionary rather than revolutionary progress is shown to be possible in grating production and contact microscopy. The photo-ionization experiment discussed is not possible without an X-ray laser. Dramatic progress is potentially possible in X-ray holography, but numerous difficulties

make this a long-term problem requiring significantly improved X-ray lasers. DOE

N87-18816# Lawrence Livermore National Lab., Calif.
SOFT X-RAY LASER CAVITIES
N. M. Ceglio, D. G. Stearns, A. M. Hawryluk, T. M. Barbee, K. Danzmann (Physikalisch-Technische Bundesanstalt, Berlin, West Germany), M. Kuehne, P. Mueller, B. Wende, M. B. Stearns (Arizona State Univ., Tempe), and A. K. Petford-Long Jul. 1986 21 p Presented at the International Colloquium on X-ray Lasers, Aussois, France, 14 Apr. 1986
(Contract W-7405-eng-48)
(DE87-003438; UCRL-95089; CONF-8604224-8) Avail: NTIS HC A02/MF A01

We report progress in the development of multilayer components for use in multiple pass soft X-ray laser cavities operating in the 100A to 300A spectral range. Our work includes fabrication and characterization of multilayer components; simple resonant cavity design; damage threshold assessment for multilayers in the X-ray laser environment; and multipass cavity experiments for efficiency enhancement and transverse mode selection. DOE

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N87-18817*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ORBITAL MANEUVERING END EFFECTORS Patent Application
W. Neill Myers, inventor (to NASA), John C. Forbes, inventor (to NASA), and Wayne L. Barnes, inventor (to NASA) Filed 16 Dec. 1986 12 p
(NASA-Case-MFS-28161-1; NAS 1.71:MFS-28161-1; US-Patent-Appl-SN-942159) Avail: NTIS HC A02/MF A01 CSCL 13I

This invention relates to an end effector device for grasping and maneuvering objects such as berthing handles of a space telescope. The device includes a V-shaped capture window defined as inclined surfaces in parallel face plates which converge toward a retainer recess in which the handle is retained. A pivotal finger (30) meshes with a pair of pivoted fingers which rotate in counterrotation. The fingers rotate to pull a handle within the capture window into recess where latches lock handle in the recess. To align the capture window, plates may be cocked plus or minus five degrees on base. Drive means is included in the form of a motor coupled with a harmonic drive speed reducer, which provides for slow movement of the fingers at a high torque so that large articles may be handled. Novelty of the invention is believed to reside in the combined intermeshing finger structure, drive means and the harmonic drive speed reducer, which features provide the required maneuverability and strength. Author

N87-18818*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MULTI-PATH PERISTALTIC PUMP Patent Application
Joseph A. Chandler, inventor (to NASA) Filed 7 Nov. 1986 15 p
(NASA-Case-MSC-20907-1; NAS 1.71:MSC-20907-1; US-Patent-Appl-SN-927992) Avail: NTIS HC A02/MF A01 CSCL 13K

The instant invention is directed to a peristaltic pump for critical laboratory or hospital applications requiring precise flow rates over an extended period of time. Within the cylindrical barrel pump housing is a single-piece, molded, elastometric, cylindrical liner with a multiplicity of flattened helical channels created therein from one end of the liner to the other. Three cylindrical rollers rotate about the center axis of the pump around the inside surface of the liner selectively compressing the liner, and hence the helical channels between the rollers and the barrel housing, creating a pumping action by forcing trapped fluid in the helical channels axially from one end of the liner to the opposite end. The novelty of the invention appears to lie in the provision of the special liner with multiple helical channels as the pumping chamber, rather than the standard single elastomeric tubing which is squeezed repeatedly by rollers to move the liquid through a typical peristaltic pump. Large, repeated deflections on the standard tubing causes a permanent set in the tubing, thus either changing the flow rate, or requiring a new section of tubing to be positioned in the pump head. Further, this configuration minimizes the amount of outflow pulsation which is characteristic of a typical single tubing peristaltic pump. Author

N87-18819*# Texas A&M Univ., College Station. Turbomachinery Labs.
AN EXPERIMENTAL AND THEORETICAL COMPARISON OF ROTORDYNAMIC COEFFICIENTS FOR SAWTOOTH-PATTERN DAMPER SEALS M.S. Thesis
Steven Anthony Nolan 1987 83 p
(Contract NAS8-35824)
(NASA-CR-179026; NAS 1.26:179026; SEAL-1-87) Avail: NTIS HC A05/MF A01 CSCL 11A

A brief review of the annular seal theory as related to rotordynamics for liquid seals is presented. Also included is an overview of Childs and Kim's current theory for calculating empirical turbulence coefficients and predicting stiffness and damping coefficients for surface roughened damper seals. The designation sawtooth-pattern refers to a seal stator with a roughness pattern whose cross section normal to the seal axis resembles a sawtooth witn the teeth directed against the flow. The net stiffness and damping coefficients for the eleven seals are compared to each other, a smooth seal, and the optimum-configuration damper seal previously tested. The experimental force coefficients, the net damping, and the net stiffness coefficients for four of the sawtooth seals are compared to the predictions of Childs and Kim's analysis. The sawtooth-pattern seal had less net damping than the hole-pattern seal but more than the smooth seal. The stiffness was comparable to the hole-pattern. Both the sawtooth and hole-pattern seals leaked less than the smooth seal, while the sawtooth-pattern seal with maximum damping leaked more than the hole-pattern seal. The theoretical predictions compared relatively poorly to the experimental results obtained for the rotordynamic coefficients of the seals investigation. Author

N87-18820*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF SURFACE REMOVAL ON ROLLING-ELEMENT FATIGUE
Erwin V. Zaretsky 1987 20 p Prepared for presentation at the International Conference on Tribology, Lubrication and Wear; 50 Years On, London, England, 1-3 Jul. 1987; sponsored by Inst. of Mechanical Engineers.
(NASA-TM-88871; E-3231; NAS 1.15:88871) Avail: NTIS HC A02/MF A01 CSCL 13I

The Lundberg-Palmgren equation was modified to show the effect on rolling-element fatigue life of removing by grinding a portion of the stressed volume of the raceways of a rolling-element bearing. Results of this analysis show that depending on the amount of material removed, and depending on the initial running time of the bearing when material removal occurs, the 10-percent life of the reground bearings ranges from 74 to 100 percent of the 10-percent life of a brand new bearing. Three bearing types were selected for testing. A total of 250 bearings were reground. Of this matter, 30 bearings from each type were endurance tested to 1600 hr. No bearing failure occurred related to material removal. Two bearing failures occurred due to defective rolling elements and were typical of those which may occur in new bearings. Author

N87-18821*# National Aeronautics and Space Administration, Washington, D.C.
TETHER DYNAMICS SIMULATION
Feb. 1987 338 p Workshop held in Arlington, Va., 16 Sep. 1986

(NASA-CP-2458; NAS 1.55:2458) Avail: NTIS HC A15/MF A01 CSCL 22B

The proceedings of the conference are presented. The objective was to provide a forum for the discussion of the structure and status of existing computer programs which are used to simulate the dynamics of a variety of tether applications in space. A major topic was different simulation models and the process of validating them. Guidance on future work in these areas was obtained from a panel discussion; the panel was composed of resource and technical managers and dynamic analysts in the tether field. The conclusions of this panel are also presented. For individual titles, see N87-18822 through N87-18824.

N87-18822*# Lang (David D.) Associates, Mercer Island, Wash.
GTOSS: GENERALIZED TETHERED OBJECT SIMULATION SYSTEM
David D. Lang *In* NASA, Washington Tether Dynamics Simulation Feb. 1987 p 73-94 (For primary document see N87-18821 11-37)
Avail: NTIS HC A15/MF A01 CSCL 22B

GTOSS represents a tether analysis complex which is described by addressing its family of modules. TOSS is a portable software subsystem specifically designed to be introduced into the environment of any existing vehicle dynamics simulation to add the capability of simulating multiple interacting objects (via multiple tethers). These objects may interact with each other as well as with the vehicle into whose environment TOSS is introduced. GTOSS is a stand alone tethered system analysis program, representing an example of TOSS having been married to a host simulation. RTOSS is the Results Data Base (RDB) subsystem designed to archive TOSS simulation results for future display processing. DTOSS is a display post processors designed to utilize the RDB. DTOSS extracts data from the RDB for multi-page printed time history displays. CTOSS is similar to DTOSS, but is designed to create ASCII plot files. The same time history data formats provided for DTOSS (for printing) are available via CTOSS for plotting. How these and other modules interact with each other is discussed. Author

N87-18823*# Aeritalia S.p.A., Torino (Italy). Space Systems Group.
TSS SUBSATELLITE ATTITUDE DYNAMICS AND CONTROL LAWS VERIFICATION PROGRAMS
Floriano Venditti *In* NASA, Washington Tether Dynamics Simulation Feb. 1987 p 187-218 (For primary document see N87-18821 11-37)
Avail: NTIS HC A15/MF A01 CSCL 22B

A dynamic model of the Tethered Satellite System (TSS) and of the relevant simulation program, developed in order to provide the dynamic analysis support for the design verification of the subsatellite attitude control, is presented. Special care was spent in the satellite attitude dynamic analysis and the model was specifically conceived to this aim. The way in which the simulation results can be utilized for the verification and testing of the attitude control is also presented. Author

N87-18824*# Turin Univ. (Italy).
RIGOROUS APPROACHES TO TETHER DYNAMICS IN DEPLOYMENT AND RETRIEVAL
Ettore Antona *In* NASA, Washington Tether Dynamics Simulation Feb. 1987 p 315-336 (For primary document see N87-18821 11-37)
Avail: NTIS HC A15/MF A01 CSCL 22B

Dynamics of tethers in a linearized analysis can be considered as the superposition of propagating waves. This approach permits a new way for the analysis of tether behavior during deployment and retrieval, where a tether is composed by a part at rest and a part subjected to propagation phenomena, with the separating section depending on time. The dependence on time of the separating section requires the analysis of the reflection of the waves travelling toward the part at rest. Such a reflection generates a reflected wave, whose characteristics are determined. The propagation phenomena of major interest in a tether are transverse waves and longitudinal waves, all mathematically modelled by the vibrating chord equations, if the tension is considered constant along the tether. An interesting problem also considered is concerned with the dependence of the tether tension from the longitudinal position, due to microgravity, and the influence of this dependence on the propagation waves. Author

N87-18825# Naval Sea Systems Command, Washington, D.C. Ship Control Systems and Equipment Division.
SELECTION PARAMETERS FOR HYDRAULIC SYSTEM FILTERS WITH A COMPARISON OF AIRCRAFT AND MARINE APPLICATIONS
Wayne K. Wilcox 1986 28 p Presented at the 23rd Annual Technical Symposium, Washington, D.C., 1986
(AD-A174045) Avail: NTIS HC A03/MF A01 CSCL 13/11

Hydraulic systems for ships and their filters have often been based on aircraft equipment and design practices. This paper compares the criteria for design and selection of filters for aircraft and ships. By considering important parameters, the designer can make a more intelligent choice in selecting filters for a particular application. Parameters discussed include filter location, essentiality and duration of operation, logistic support requirements, and maintenance philosophy, including costs. While most of the parameters for filter selection are similar for aircraft and ships there are important differences which must be considered. Dirt capacity requirements for military aircraft filters are generally inadequate for ship hydraulic systems as well as commercial aircraft. By considering the various design and maintenance requirements, improved filtration can be provided for ship hydraulic systems at lower life cycle costs than at present although initial costs may be slightly higher. GRA

N87-18826# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
TRAJECTORY AND FORCE CONTROL OF A DIRECT DRIVE ARM
Chae H. An Sep. 1986 163 p
(Contracts N00014-85-K-0124; N00014-82-K-0334)
(AD-A174405; AI-TR-912) Avail: NTIS HC A08/MF A01 CSCL 09/5

Using the MIT Serial Link Direct Drive Arm as the main experimental device, various issues in trajectory and force control of manipulators were studied. Since accurate modelling is important for any controller, issues of estimating the dynamic model of a manipulator and its load were addressed first. Practical and effective algorithms were developed from the Newton-Euler equations to estimate the inertial parameters of manipulator rigid-body loads and links. Load estimation was implemented both on a PUMA 600 robot and on the MIT Serial Link Direct Drive Arm. With the link estimation algorithm, the inertial parameters of the direct drive arm were obtained. For both load and link estimation results, the estimated parameters are good models of the actual system for control purposes since torques and forces can be predicted accurately from these estimated parameters. The estimated model of the direct drive arm was then used to evaluate trajectory following performance by feedforward and computed torque control algorithms. The experimental evaluations showed that the dynamic compensation can greatly improve trajectory following accuracy. GRA

N87-18827# North Staffordshire Polytechnic, Stafford (England). Dept. of Mechanical and Computer-Aided Engineering.
VIBRATION CONTROL IN ROTATING MACHINERY USING VARIABLE DYNAMIC STIFFNESS SQUEEZE-FILMS, VOLUME 1 Annual Report, Sep. 1984 - Mar. 1986
M. P. Goodwin and M. J. Roach Mar. 1986 52 p
(Grant AF-AFOSR-0368-84)
(AD-A174417; AFOSR-86-1098-Vol-1; AR-1) Avail: NTIS HC A04/MF A01 CSCL 13/9

This report describes the current status of a research project whose aim is to develop a hydrostatic bearing, for rotating machinery, whose dynamic characteristics may be tuned during operation of the machine. The purpose of this is to enable the operator to exercise some control over machine critical speeds

and vibrations. A computer program has been written which will predict both the static and dynamic characteristics of a hydrostatic bearing. The program allows for the presence of accumulators linked to the hydrostatic bearing recessess via flow restrictors. Output from the computer program has been used as input data to a second computer program which calculates machine vibration amplitude variation running speed. Theoretical machine characteristics obtained in this way have been used to aid the design of a test rig which will be used to examine the practical performance of the new bearing type being developed. GRA

N87-18828# North Staffordshire Polytechnic, Stafford (England). Dept. of Mechanical and Computer-Aided Engineering.
VIBRATION CONTROL IN ROTATING MACHINERY USING VARIABLE DYNAMIC STIFFNESS SQUEEZE FILMS, VOLUME 2 Annual Interim Report, Sept. 1984 - Mar. 1986
M. J. Goodwin and M. P. Roach Mar. 1986 53 p
(Grant AF-AFOSR-0368-84)
(AD-A174433; AFOSR-86-1098-Vol-2; AIR-1) Avail: NTIS HC A04/MF A01 CSCL 13/9

This report describes the current status of a research project whose aim is to develop a hydrostatic bearing, for rotating machinery, whose dynamic characteristics may be tuned during operation of the machine. The purpose of this is to enable the operator to exercise some control over machine critical speeds and vibrations. A computer program has been written which will predict both the static and dynamic characteristics of a hydrostatic bearing. The program allows for the presence of accumulators linked to the hydrostatic bearing recesses via flow restrictors. Output from the computer program has been used as input data to a second computer program which calculates machine vibration amplitude variation with running speed. Theoretical machine characteristics obtained in this way have been used to aid the design of a test rig which will be used to examine the practical performance of the new bearing type being developed. GRA

N87-18829# Massachusetts Inst. of Tech., Cambridge. Gas Turbine and Plasma Dynamics Lab.
FLUID DYNAMIC-STRUCTURAL INTERACTIONS OF LABYRINTH SEALS Final Report, 1 Dec. 1982 - 30 Nov. 1983
Manuel Martinez-Sanchez and John Dugundji 3 Jun. 1986 33 p
(Grant AF-AFOSR-0034-83)
(AD-A174461; AFOSR-86-2004TR) Avail: NTIS HC A03/MF A01 CSCL 11/1

An analytical model was formulated for the calculation of unsymmetrical pressure distributions inside the cavities of a multi-stage labyrinth seal. The model is based on a set of linearized continuity and momentum equations for the throughflow, and can account for the effects of rotation, whirl, flow swirl, differential gap width and (limited) compressibility. Preliminary calculations show excellent agreement with non-whirling side-force data in the literature. Also, models are being constructed permitting calculation of the effect of these seal forces on the running stability of flexible, highly loaded turbomachines, with the Space Shuttle Main Engine serving as the prototype of such machines. GRA

N87-18830# Massachusetts Inst. of Tech., Cambridge. Gas Turbine and Plasma Dynamics Lab.
FLUID DYNAMIC-STRUCTURAL INTERACTIONS OF LABYRINTH SEALS Final Report, 1 Dec. 1983 - 31 Dec. 1984
Manuel Martinez-Sanchez and John Dugundji Aug. 1986 40 p
(Grant AF-AFOSR-0034-83)
(AD-A174780; AFOSR-86-2039TR) Avail: NTIS HC A03/MF A01 CSCL 11/2

Work is described on a continuing investigation into the fluid dynamic and structural interactions of labyrinth seals. Three major areas are considered: (1) design and construction of a realistic labyrinth seal test rig to measure stiffness and damping forces in seals; (2) further development of an analytic labyrinth seal test model and its characteristics; and (3) formulation of a structural dynamic rotor system model including labyrinth seal forces and their application to the High Pressure Fuel Turbopump of the Space Shuttle main engine. GRA

N87-18831# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
APPLICATION OF ROBOTICS IN NUCLEAR FACILITIES
J. S. Byrd and J. J. Fisher 1986 19 p Presented at the DOE/ANL Training Course, Gaithersburg, Md., 24 Feb. 1986
(Contract DE-AC09-76SR-00001)
(DE86-015689; DP-MS-86-16; CONF-860262-2) Avail: NTIS HC A02/MF A01

Industrial robots and other robotic systems have been successfully applied at the Savannah River nuclear site. These applications, new robotic systems presently under development, general techniques for the employment of robots in nuclear facilities, and future systems are discussed. DOE

N87-18832# Pacific Northwest Labs., Richland, Wash.
TRIBOLOGICAL SINKS IN EMERGING INDUSTRIES: ELECTRONICS AND ROBOTICS
J. A. Russell and G. J. Hane Aug. 1986 63 p
(Contract DE-AC06-76RL-01830)
(DE86-015816; PNL-5968) Avail: NTIS HC A04/MF A01

A preliminary review is made of the impact of tribological effects - losses due to friction and wear - in two emerging industries: robotics and electronics. Major sources of tribological wear in the robotics industry include the chains used to drive the robots and the joints in the elbow and wrist. In the electronics industry, the largest source of tribological wear is the particulate wear of vacuum pumps used in corrosive environments. Other significant sources of wear are the conveyor belts, blowers, and fans used for clean rooms, and the slicing, lapping and polishing operations for silicon wafers. The major loss mechanisms are friction and abrasion (abrasion includes 2-body wear, 3-body wear, gouging, grinding, erosion, and cutting wear). DOE

N87-18833# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
ROBOTIC APPLICATIONS AT SAVANNAH RIVER SITE
J. S. Byrd Mar. 1986 26 p Presented at the 13th Annual Energy Technology Conference and Exposition (ET '86), Washington, D.C., 17 Mar. 1986
(Contract DE-AC09-76SR-00001)
(DE86-015852; DP-MS-85-144; CONF-860303-7) Avail: NTIS HC A03/MF A01

The Savannah River Plant has been operated for the Department of Energy by E.I. duPont de Nemours and Company as a highly automated nuclear production facility since 1953. A Robotics Technology Group was organized at the Savannah River Laboratory in 1982 to enhance the existing automation and new processes with modern robotics technology. Several new robotic systems have been installed in plant processes, and other development work is under way for automation in fuel manufacturing, production reactor operations, process sampling operations, and laboratory analyses. This paper discusses site applications that employ industrial robots, mobile vehicles, and special automated systems. Development plans for R and D programs in intelligent robot systems, using expert systems and artificial intelligence techniques, are also discussed. DOE

N87-18834# Allied Bendix Aerospace, Kansas City, Mo.
IC HANDLING ROBOT
D. O. Law Sep. 1986 20 p
(Contract DE-AC04-76DP-00613)
(DE86-015993; BDX-613-3553) Avail: NTIS HC A02/MF A01

Allied Corporation, Bendix Kansas City Division uses many integrated circuits (ICs) which are 100% tested by receiving inspection prior to installation into the next assemblies. Testing includes functional testing followed by a burn-in cycle, then additional functional testing. Before an IC can be functionally tested, it must be inserted into a custom plastic carrier which is placed into a metal magazine that fits the functional tester. The ICs are removed from both tester magazines and carriers prior to being placed into connectors mounted on a printed wiring board for burn-in. Then they are removed from the burn-in board and re-inserted into carriers and magazines for additional functional testing. Each device is handled manually a minimum of 12 times before it is accepted. This project established a robotic workcell

which automatically prepares a dual in-line packaged (DIP) integrated circuit for several types of inspection operations performed by Receiving Inspection. Specific activities required to accomplish this goal included definition of the work cell, preparation of the robot and other equipment specifications, installation planning, establishment of programming routines and logic, design of operator safeguards, and development of the work cell concept into an operational unit capable of supporting production. DOE

N87-18835# Allied Bendix Aerospace, Kansas City, Mo.
ROBOTIC SYSTEM FOR DEBURRING MACHINED CASTINGS
R. J. Lambrechts Sep. 1986 28 p
(Contract DE-AC04-76DP-00613)
(DE86-016112; BDX-613-3587) Avail: NTIS HC A03/MF A01

A robot has been established in a work cell to deburr machined aluminum and stainless steel castings. The work cell increases the speed and repeatability of the process. Descriptions of the work cell components, process requirements, programming techniques, and problems encountered during development are presented. DOE

N87-18836# Lawrence Livermore National Lab., Calif.
FIBER/EPOXY FILAMENT-WOUND VESSELS Final Report
T. T. Chiao and R. L. Moore 14 Aug. 1986 11 p
(Contract W-7405-eng-48)
(DE87-000039; UCID-20845) Avail: NTIS HC A02/MF A01

The present investigation has provided a valuable insight into the design, fabrication and performance of filament-wound pressure vessels. The long-term stress rupture data generated under the contract is perhaps the only available lifetime data of its kind for Kevlar 49/epoxy pressure vessels. Now, it is clear that Kevlar 49/epoxy pressure vessels can be made to last at least 9 years at 50% of the static burst pressure. DOE

N87-18837# Allied Bendix Aerospace, Kansas City, Mo. Technical Communications Dept.
A ROBOTIC BURNISHING SYSTEM FOR SOLID FILM LUBRICANT COATED PARTS
M. L. Fureigh May 1986 22 p
(Contract DE-AC04-76DP-00613)
(DE86-010774; BDX-613-3479) Avail: NTIS HC A02/MF A01

A robotic burnishing system in the Painting Department reduced the operation average standard hour content by 64 percent and maintains a good part-to-part quality level for a group of parts coated with solid film lubricant. Required to be safe and simple to operate, the system uses a small PUMA 260 robot to process coated axisymmetrical pieceparts. Special tooling and seven pairs of robotic fingers were designed and built to handle 24 different small pieceparts. Individual robotic programs were created for each part and stored on 5-1/4 in. floppy disks with backup copies in Numerical Control. The operators and the manufacturing department readily accepted the robotic system. Additional part geometries will be developed for robotic processing. Author

N87-18838# Los Alamos National Lab., N. Mex.
CORRELATION TECHNIQUE FOR SINGLE- AND TWO-PHASE PUMP DATA
M. Bozoian 1986 7 p Presented at the American Nuclear Society and Atomic Industrial Forum Joint Meeting, Washington, D.C., 16 Nov. 1986
(Contract W-7405-eng-36)
(DE86-012418; LA-UR-86-2285; CONF-861102-2) Avail: NTIS HC A02/MF A01

This paper presents a correlation method for single- and two-phase pump data. DOE

N87-18839# Argonne National Lab., Ill.
STIRLING ENGINE RESEARCH AT ARGONNE NATIONAL LABORATORY
R. E. Holtz, J. G. Daley, and P. D. Roach Jun. 1986 17 p Presented at the 3rd International Stirling Engine Conference, Rome, Italy, 1 Jun. 1986
(Contract W-31-109-eng-38)
(DE86-014556; CONF-860676-3) Avail: NTIS HC A02/MF A01

Stirling engine research at Argonne National Laboratory has been focused at (1) development of mathematical models and analytical tools for predicting component and engine performance, and (2) experimental research into fundamental heat transfer and fluid flow phenomena occurring in Stirling cycle devices. A result of the analytical effort has been the formation of a computer library specifically for Stirling engine researchers and developers. The library contains properties of structural materials commonly used, thermophysical properties of several working fluids, correlations for heat transfer calculations and general specifications of mechanical arrangements (including various drive mechanisms) which can be utilized to model a particular engine. The library also contains alternative modules to perform analysis at different levels of sophistication, including design optimization. A reversing flow heat transfer facility is operating at Argonne to provide data at prototypic Stirling engine operating conditions under controlled laboratory conditions. This information is needed to validate analytical models. DOE

N87-18840# Pacific Northwest Labs., Richland, Wash.
DESIGN OF A HIGH-POWER DENSITY LJUNGSTROM TURBINE USING POTASSIUM AS A WORKING FLUID
E. P. Coomes, R. E. Dodge, D. G. Wilson (Massachusetts Inst. of Tech., Cambridge), and S. J. McCabe Apr. 1986 7 p Presented at the Intersociety Energy Conversion Engineering Conference, San Diego, Calif., 25 Aug. 1986 Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge
(Contract DE-AC06-76RL-01830)
(DE86-015056; PNL-SA-13700; CONF-860810-26) Avail: NTIS HC A02/MF A01

Large quantities of high-quality power will be necessary to meet the needs of many proposed future space programs. An advanced multi-megawatt space power system employing a liquid metal Rankine power cycle is considered. One component of the system, the power turbine, is closely examined. The turbine design selected is a counter-rotating radial-outflow machine developed in the early twentieth century by the brothers Ljungstroem. It was selected because it provides a compact, high-power-density turbine with balanced rotational inertia and is tolerant of moisture in the working fluid. In commercial operation, Ljungstroem turbines have demonstrated excellent rapid start capabilities and good overall efficiency. Moreover, the disadvantages that have hindered its use in conventional power plants are tied to the steam's very large change in specific volume. These disadvantages are circumvented in a Ljungstroem turbine using potassium for a working fluid, and that the latter with a capacity of 200 MW and greater could easily fit into the cargo bay of the Space Shuttle. DOE

N87-18841# Little (Arthur D.), Inc., Cambridge, Mass.
STATUS OF FREE PISTON STIRLING ENGINE DRIVEN HEAT PUMPS: DEVELOPMENT, ISSUES, AND OPTIONS Final Report
Apr. 1986 201 p Prepared in cooperation with Oak Ridge National Lab., Tenn.
(Contract DE-AC05-84OR-21400)
(DE87-001595; ORNL/Sub-84-00205/1) Avail: NTIS HC A10/MF A01

This report summarizes the results of a program to review the recent experience with free piston Stirling engine (FPSE) driven heat pump systems and to identify key technical and cost issues which should be the focus of the future program efforts. The effort emphasizes experience with the programs undertaken by General Electric Company (inertial compressor concept) and Mechanical Technology, Inc. (hydraulically coupled system) since they have received the major funding by the Department of Energy and others since the late 1970's. Issues addressed by the study include the status and prospects of FPSEs as heat pump drives, design and operational characteristics which might limit reliability and life, unique factors such as gas spring losses, influencing the efficiency of FPSE, and the cost constraints on the system to be economically competitive with conventional equipment and other heat actuated heat pump options. Special

attention was given to the impacts of unlubricated seal and bearing options on system life, reliability, and cost. DOE

N87-18842# Sandia National Labs., Albuquerque, N. Mex.
INVESTIGATION OF THE SINGLE CLINCH SLEEVE TUBE FITTING
C. M. Hinckley Oct. 1986 49 p
(Contract DE-AC04-76DP-00789)
(DE87-002345; SAND-78-8262) Avail: NTIS HC A03/MF A01

Both computational and experimental methods have been applied in assessing techniques for assembling clinch sleeve fittings on 3.18 mm (1/8 in.) OD tubing. Stress levels and plastic deformations were predicted by numerical analysis. The effects of lubrication and torquing speed were determined experimentally. Torque versus nut rotation relationships obtained by numerical methods correlated well with experimental results, leading to a series of detailed recommendations for assembling and tightening the fittings. The results also indicate that clinch sleeve fittings should be able to seal against pressures as great as 207 MPa (30 ksi) with a safety factor of 1.5. DOE

N87-18843# Lawrence Livermore National Lab., Calif.
REPORT OF THE FIRST DOE AD-HOC COMMITTEE MEETING ON AE MONITORING OF PINCH WELDING
C. A. Tatro Sep. 1986 93 p
(Contract W-7405-eng-48)
(DE87-001451; UCID-20872) Avail: NTIS HC A05/MF A01

This report is a summary of a DOE-wide meeting on the acoustic emission (AE) monitoring of pinch welding. It was held at Savannah River Plant in April 1984. The meeting was co-chaired by the author and Raymond R. Lawson of Savannah River Plant. DOE

N87-18844# Chicago Univ., Ill.
STUDIES IN FINITE TIME THERMODYNAMICS Progress Report, 1 Apr. 1986 - 31 Mar. 1987
R. S. Berry Oct. 1986 11 p
(Contract DE-FG02-86ER-13488)
(DE87-003574; DOE/ER-13488/1) Avail: NTIS HC A02/MF A01

During the year, we completed our study of light-driven dissipative engines. This work began with the demonstration of requirements for a dissipative system to be a work source and of how certain model systems can meet those requirements. The next step applied the concept to a simple but relatively realistic system in which the working substance has two chemical forms with the same mole number for each, i.e., A in equilibrium B, and the heating via light is simplified into a Heaviside step function. The conclusion of the work for the present is the analysis just completed which is based on the real system of the fluorosulfate radical SO3F and its dimer in an inert carrier as the working fluid. DOE

N87-18845# Sandia National Labs., Albuquerque, N. Mex.
HEAT ENGINE DEVELOPMENT FOR SOLAR THERMAL DISH-ELECTRIC POWER PLANTS
K. L. Linker Nov. 1986 33 p
(Contract DE-AC04-76DP-00789)
(DE87-003583; SAND-86-0289) Avail: NTIS HC A03/MF A01

The Department of Energy's (DOE) Solar Thermal Program has as one of its elements the development and evaluation of heat engine technologies applicable to Distributed Receiver Systems. The primary research and development activities, for the past several years, have involved the so-called dish-electric concept in which a heat engine, solar receiver, and generator are coupled and located at the focus of a parabolic dish concentrator. Power conversion assemblies (PCA) would be deployed at the size of about 25 to 50 kWe, which is consistent with concentrator development in the 11 to 15 m diameter range. This report describes various heat engine cycles, outlines the status of their development, presents test data and performance evaluation from experimental work to date, and discusses the strategy for future development efforts. DOE

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N87-18846# Naval Postgraduate School, Monterey, Calif.
RELIABILITY IN A RANDOM ENVIRONMENT Technical Report, Oct. 1985 - Sep. 1986
Edward B. Rockower Oct. 1986 28 p
(AD-A174320; NPS55-86-018) Avail: NTIS HC A03/MF A01 CSCL 12/2

Correlations in the failures of subsystems or components may arise when they share a common, random environment. It is shown that a natural tool for calculating the reliability of such systems is the characteristic functional of the random hazard rate, h(t). Some general results for the reliability of series and parallel systems in terms of the characteristic functional of the hazard rate are derived and applied to a number of models of random environments. The applications include random hazard functions arising from: (1) non-fatal shocks of random amplitudes, (2) a Markovian, Gamma-marginal stochastic process, (3) system stress related to unrepaired damage from incoming rounds, and (4) impulsive and accumulated heat stresses from a laser battle. GRA

N87-18847# Rome Air Development Center, Griffiss AFB, N.Y.
RADC (ROME AIR DEVELOPMENT CENTER) GUIDE TO ENVIRONMENTAL STRESS SCREENING Report, for 1985 - 1986
Eugene Fiorentino Aug. 1986 156 p
(AD-A174333; RADC-TR-86-138) Avail: NTIS HC A08/MF A01 CSCL 14/4

This in-house report (guidebook) provides guidelines and techniques for conducting Environmental Stress Screening (ESS) programs during development and production. ESS is a process whereby environmental stimuli are applied to electronic equipment in order to precipitate latent defects to early failure. Methods and procedures are provided for screening and eliminating defective parts, workmanship and process induced defects from electronic items during the manufacturing process. The methodology contained in the report enables the user to plan, monitor and control the screening process so as to achieve quantitative reliability objectives in a cost-effective manner. The report has been prepared in MIL-HDBK format so as to serve as a basis for a DOD handbook on ESS. Comments received on a previously circulated draft MIL-STD on ESS have been incorporated in the report. Use of the report (guidebook) will foster the development of a broader data base through which the ESS methodology can be refined. GRA

N87-18848# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
ANALYSIS OF A STOCHASTIC MODEL TO DETERMINE FAILURE RATES FOR COMMUNICATION-ELECTRONIC SYSTEMS M.S. Thesis
Thomas M. Skowronek Sep. 1986 114 p
(AD-A174394; AFIT/GLM/LSM/86S-77) Avail: NTIS HC A06/MF A01 CSCL 14/4

Work accomplished by headquarters Air Force Logistics Command (AFLC) demonstrates a need to consider both on-time and off-time failures when computing communication-electronic spares requirements. However, AFLC has been unable to verify and validate a method that would integrate both failure types into a single requirements algorithm. This thesis attempts to verify and validate a method which integrates the two distributions. On-time failures are derived through a stochastic growth process, where expected on-failures are divided by expected off-failures, then multiplied by both an initial off-failure rate and power-ups. The initial off-failure rate equals expected off-failures divided by average power-ups attempted. Off-failures occur through unsuccessful attempts to power-up a system. GRA

N87-18849# North Carolina Univ., Charlotte. Dept. of Mathematics.
MARKOVIAN SHOCK MODELS, DETERIORATION PROCESSES, STRATIFIED MARKOV PROCESSES REPLACEMENT POLICIES Final Report, 1 Jul. 1980 - 31 Dec. 1985
M. Abdel-Hameed 31 Dec. 1985 25 p
(Grant AF-AFOSR-0245-80)
(AD-A174646; AFOSR-86-0371TR) Avail: NTIS HC A02/MF A01 CSCL 14/4

Research topics included shock and wear processes, optimal maintenance and replacement policies, positive dependence of components, life distribution properties of devices, analysis of censored failure time data, and accelerated life testing of systems. GRA

N87-18850# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
ULTRASONIC DETECTION OF LAMINAR-TYPE DEFECTS IN IRIDIUM ALLOY BLANKS
K. V. Cook, R. A. Cunningham, Jr., W. A. Simpson, Jr., and R. W. McClung Jul. 1986 23 p
(Contract DE-AC05-84OR-21400)
(DE86-015976; ORNL-6290) Avail: NTIS HC A02/MF A01

Encapsulated isotopic heat sources for use in generating electrical power for space applications require flight-quality hardware material. Iridium is the chosen material for such applications, and Oak Ridge National Laboratory has been the prime supplier of iridium alloy forming blanks 52 mm in diameter by 0.66 mm thick (1.0 by 0.026 in.). Prior to the work reported here, these blanks were ultrasonically examined by using 0.9-mm-diam (0.035-in.) simulated flaw standards. However, as a result of this effort, the sensitivity of our ultrasonic pulse-echo test system has been increased. The improved ultrasonic test system permits blank inspection at the 0.5-mm-diam (0.020-in.) simulated flaw detection level. This test system was successfully demonstrated on the initial blanks provided via an improved processing route (consumable arc-melting, extruding, and rolling). The equipment modification and/or selection and the specific focused search unit immersion technique developed to provide this capability are described. The improved flaw detection capability also provides data maps of a comm on type of defect in iridium (delaminations). DOE

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N87-18851 Michigan Univ., Ann Arbor.
YIELD POINT LOAD FOR PLATES Ph.D. Thesis
Rui Carlos Orlandi 1986 184 p
Avail: Univ. Microfilms Order No. DA8621350

The determination of upper bounds on the yield point load of thin plates is considered. The basic equations based on the assumptions of the conventional thin plate engineering theory are presented together with a yield criterion based on the Frobenius norm of a matrix. The field equations are classified according to the admissibility of discontinuities in the field quantities. A variational principle producing lower and upper bound formulations for the yield point load for plates is discussed with careful consideration of the boundary conditions. Least upper bounds are searched by utilizing a series representation of the velocity field. An iterative algorithm for the minimization problem is applied in connection with a special scheme of subspace iteration. The procedure is successfully tested on a beam and various circular plate problems. New solutions for simply supported and clamped rectangular plates are presented both for plates obeying the new yield criterion and the von Mises yield criterion. Dissert. Abstr.

N87-18852*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Engineering Mechanics.
A CONSTITUTIVE MODEL FOR THE INELASTIC MULTIAXIAL CYCLIC RESPONSE OF A NICKEL BASE SUPERALLOY RENE 80 Ph.D. Thesis. Final Report
V. G. Ramaswamy Washington NASA Jul. 1986 245 p Previously announced as N86-25472
(Contract NAS3-23927)
(NASA-CR-3998; E-3069; NAS 1.26:3998) Avail: NTIS HC A11/MF A01 CSCL 20K

The objective was to develop unified constitutive equations which can model a variety of nonlinear material phenomena observed in Rene 80 at elevated temperatures. A constitutive model was developed based on back stress and drag stress. The tensorial back stress was used to model directional effects; whereas, the scalar drag stress was used to model isotropic effects and cyclic hardening or softening. A flow equation and evolution equations for the state variables were developed in multiaxial form. Procedures were developed to generate the material parameters. The model predicted very well the monotonic tensile, cyclic, creep, and stress relaxation behavior of Rene 80 at 982 C. The model was then extended to 871, 760, and 538 C. It was shown that strain rate dependent behavior at high temperatures and strain rate independent behavior at the lower temperatures could be predicted very well. A large number of monotonic tensile, creep, stress relation, and cyclic experiments were predicted. The multiaxial capabilities of the model were verified extensively for combined tension/torsion experiments. The prediction of the model agreed very well for proportional, nonproportional, and pure shear cyclic loading conditions at 982 and 871 C. Author

N87-18853# Queensland Univ., St. Lucia (Australia). Dept. of Civil Engineering.
BUCKLING OF MONOSYMMETRIC I-BEAMS UNDER MOMENT GRADIENT
S. Kitipornchai, C. M. Wang (National Univ. of Singapore), and N. S. Trahair (Sydney Univ., Australia) Oct. 1985 43 p
(CE-61) Avail: NTIS HC A03/MF A01

The elastic lateral buckling of simply supported monosymmetric I-beams under moment gradient is investigated. Independent solutions are obtained using the finite integral method and the Rayleigh-Ritz energy approach. The elastic buckling moments depend on the degree of beam monosymmetry, rho, the beam parameter, K, and the end moment ratio, beta. Buckled mode shapes reveal that the buckling deformations of the beams have complicated forms. It is found that the present design moment modification factor formula cannot satisfactorily predict the buckling capacities of monosymmetric I-beams. An alternative approximate buckling formula is proposed. Author

N87-18854# Queensland Univ., St. Lucia (Australia). Dept. of Civil Engineering.
BUCKLING CAPABILITIES OF MONOSYMMETRIC I-BEAMS
C. M. Wang and S. Kitipornchai Oct. 1985 43 p
(CE-62) Avail: NTIS HC A03/MF A01

The elastic lateral buckling of simply supported monosymmetric I-beams under transverse loads are examined. Solutions are obtained in terms of the easily evaluated degree of beam monosymmetry, rho and the beam parameter, K. It was found that the moment modification factors of double symmetric I-beams presently used in design formulae to predict the buckling capacities of monosymmetric I-beams could be unsafe. Consequently, alternative simple approximate formulae are derived from the energy method, based on the study of the buckled mode shapes of monosymmetric I-beams. The proposed formulae retain the familiar form of the well known solution of beams under uniform moment. Moreover, guidelines are given for achieving the optimum degrees of beam monosymmetry. Author

N87-18855*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SENSITIVITY ANALYSIS IN ENGINEERING
Howard M. Adelman, comp. and Raphael T. Haftka, comp. (Virginia

Polytechnic Inst. and State Univ., Blacksburg) Feb. 1987 369 p Symposium held in Hampton, Va., 25-26 Sep. 1986
(NASA-CP-2457; L-16278; NAS 1.55:2457) Avail: NTIS HC A16/MF A01 CSCL 20K

The symposium proceedings presented focused primarily on sensitivity analysis of structural response. However, the first session, entitled, General and Multidisciplinary Sensitivity, focused on areas such as physics, chemistry, controls, and aerodynamics. The other four sessions were concerned with the sensitivity of structural systems modeled by finite elements. Session 2 dealt with Static Sensitivity Analysis and Applications; Session 3 with Eigenproblem Sensitivity Methods; Session 4 with Transient Sensitivity Analysis; and Session 5 with Shape Sensitivity Analysis. For individual titles, see N87-18856 through N87-18878.

N87-18856*# Princeton Univ., N. J. Dept. of Chemistry.
ON DETERMINING IMPORTANT ASPECTS OF MATHEMATICAL MODELS: APPLICATION TO PROBLEMS IN PHYSICS AND CHEMISTRY **c64**
Herschel Rabitz *In* NASA. Langley Research Center Senstivity Analysis in Engineering Feb. 1987 p 1-9 Sponsored in part by ONR (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 12A

The use of parametric and functional gradient sensitivity analysis techniques is considered for models described by partial differential equations. By interchanging appropriate dependent and independent variables, questions of inverse sensitivity may be addressed to gain insight into the inversion of observational data for parameter and function identification in mathematical models. It may be argued that the presence of a subset of dominantly strong coupled dependent variables will result in the overall system sensitivity behavior collapsing into a simple set of scaling and self similarity relations amongst elements of the entire matrix of sensitivity coefficients. These general tools are generic in nature, but herein their application to problems arising in selected areas of physics and chemistry is presented. Author

N87-18857*# George Washington Univ., Washington, D.C. Dept. of Operations Research.
COMPUTABLE OPTIMAL VALUE BOUNDS FOR GENERALIZED CONVEX PROGRAMS **c61**
Anthony V. Fiacco and Jerzy Kyparisis (Florida International Univ., Miami) *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 11-18 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 09B

It has been shown by Fiacco that convexity or concavity of the optimal value of a parametric nonlinear programming problem can readily be exploited to calculate global parametric upper and lower bounds on the optimal value function. The approach is attractive because it involves manipulation of information normally required to characterize solution optimality. A procedure is briefly described for calculating and improving the bounds as well as its extensions to generalized convex and concave functions. Several areas of applications are also indicated. Author

N87-18858*# California Univ., Santa Barbara.
ALTERNATIVE METHODS FOR CALCULATING SENSITIVITY OF OPTIMIZED DESIGNS TO PROBLEM PARAMETERS **c64**
G. N. Vanderplaats and H. D. Cai (Engineering Design Optimization, Inc., Santa Barbara, Calif.) *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 19-32 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 12A

Optimum sensitivity is defined as the derivative of the optimum design with respect to some problem parameter, P. The problem parameter is usually fixed during optimization, but may be changed later. Thus, optimum sensitivity is used to estimate the effect of changes in loads, materials or constraint bounds on the design without expencive re-optimization. Here, the general topic of optimum sensitivity is discussed, available methods identified, examples given, and the difficulties encountered in calculating this information in nonlinear constrained optimization are identified. Author

N87-18859*# California Univ., Los Angeles.
BEHAVIOR SENSITIVITIES FOR CONTROL AUGMENTED STRUCTURES
R. A. Manning, R. V. Lust, and L. A. Schmit *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 33-57 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 20K

During the past few years it has been recognized that combining passive structural design methods with active control techniques offers the prospect of being able to find substantially improved designs. These developments have stimulated interest in augmenting structural synthesis by adding active control system design variables to those usually considered in structural optimization. An essential step in extending the approximation concepts approach to control augmented structural synthesis is the development of a behavior sensitivity analysis capability for determining rates of change of dynamic response quantities with respect to changes in structural and control system design variables. Behavior sensitivity information is also useful for man-machine interactive design as well as in the context of system identification studies. Behavior sensitivity formulations for both steady state and transient response are presented and the quality of the resulting derivative information is evaluated. Author

N87-18860*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SENSITIVITY METHOD FOR INTEGRATED STRUCTURE/ ACTIVE CONTROL LAW DESIGN
Michael G. Gilbert *In its* Sensitivity Analysis in Engineering Feb. 1987 p 59-75 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 20K

The development is described of an integrated structure/active control law design methodology for aeroelastic aircraft applications. A short motivating introduction to aeroservoelasticity is given along with the need for integrated structures/controls design algorithms. Three alternative approaches to development of an integrated design method are briefly discussed with regards to complexity, coordination and tradeoff strategies, and the nature of the resulting solutions. This leads to the formulation of the proposed approach which is based on the concepts of sensitivity of optimum solutions and multi-level decompositions. The concept of sensitivity of optimum is explained in more detail and compared with traditional sensitivity concepts of classical control theory. The analytical sensitivity expressions for the solution of the linear, quadratic cost, Gaussian (LQG) control problem are summarized in terms of the linear regulator solution and the Kalman Filter solution. Numerical results for a state space aeroelastic model of the DAST ARW-II vehicle are given, showing the changes in aircraft responses to variations of a structural parameter, in this case first wing bending natural frequency. Author

N87-18861*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE CASE FOR AERODYNAMIC SENSITIVITY ANALYSIS **c02**
Jaroslaw Sobieszczanski-Sobieski *In its* Sensitivity Analysis in Engineering Feb. 1987 p 77-96 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 01A

No specific solutions are offered, nor verified by applications, for its subject problem which is sensitivity analysis in Computational Fluid Dynamics (CFD). Instead, a plea is made to the CFD community for extending their present capability to include sensitivity analysis. The plea is made from the viewpoint of an aeronautical engineer, not an expert in CFD methods, who needs the sensitivity information when working at the junction of aerodynamics, structures, active controls, and other disciplines whose inputs need to be integrated in aircraft design. Author

N87-18862*# Ford Motor Co., Dearborn, Mich. Vehicle Methods and Components Dept.

SENSITIVITY OF OVERALL VEHICLE STIFFNESS TO LOCAL JOINT STIFFNESS

Choon T. Chon *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 97-112 (For primary document see N87-18855 11-39)

Avail: NTIS HC A16/MF A01 CSCL 20K

How overall vehicle stiffness is affected by local joint stiffness is discussed. By using the principle of virtual work and the minimum strain energy theorem, a closed form expression for the sensitivity coefficient was derived. The insensitivity of the vehicle stiffness to a particular joint, when its stiffness exceeds a certain value (or threshold value), was proven mathematically. In order to investigate the sensitivity of the structure to the joint stiffness, a so-called stick model was created, and the modeling technique is briefly described. Some data on joint stiffness of tested vehicles are also presented. Author

N87-18863*# Iowa Univ., Iowa City. Optimal Design Lab.

DESIGN SENSITIVITY ANALYSIS OF NONLINEAR STRUCTURAL RESPONSE

J. B. Cardoso and J. S. Arora *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 113-132 (For primary document see N87-18855 11-39)

Avail: NTIS HC A16/MF A01 CSCL 20K

A unified theory is described of design sensitivity analysis of linear and nonlinear structures for shape, nonshape and material selection problems. The concepts of reference volume and adjoint structure are used to develop the unified viewpoint. A general formula for design sensitivity analysis is derived. Simple analytical linear and nonlinear examples are used to interpret various terms of the formula and demonstrate its use. Author

N87-18864*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.

OPTIMAL CONTROL CONCEPTS IN DESIGN SENSITIVITY ANALYSIS

Ashok D. Belegundu *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 133-145 (For primary document see N87-18855 11-39)

Avail: NTIS HC A16/MF A01 CSCL 20K

A close link is established between open loop optimal control theory and optimal design by noting certain similarities in the gradient calculations. The resulting benefits include a unified approach, together with physical insights in design sensitivity analysis, and an efficient approach for simultaneous optimal control and design. Both matrix displacement and matrix force methods are considered, and results are presented for dynamic systems, structures, and elasticity problems. Author

N87-18865*# MacNeal-Schwendler Corp., Los Angeles, Calif.

SENSITIVITY AND OPTIMIZATION OF COMPOSITE STRUCTURES USING MSC/NASTRAN

Gopal K. Nagendra and Claude Fleury (California Univ., Los Angeles) *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 147-166 (For primary document see N87-18855 11-39)

Avail: NTIS HC A16/MF A01 CSCL 20K

Design sensitivity analysis for composites will soon be available in MSC/NASTRAN. The design variables for composites can be lamina thicknesses, orientation angles, material properties or a combination of all three. With the increasing use of composites in aerospace and automotive industries, this general capability can be used in its own right for carrying out sensitivity analysis of complicated real-life structures. As part of a research effort, the sensitivity analysis was coupled with a general purpose optimizer. This preliminary version of the optimizer is capable of dealing with minimum weight structural design with a rather general design variable linking capability at the element level or system level. Only sizing type of design variables (i.e., lamina thicknesses) can be handled by the optimizer. Test cases were run and validated by comparison with independent finite element packages. The linking of design sensitivity capability for composites in MSC/NASTRAN with an optimizer would give designers a powerful automated tool to carry out practical opitmization design of real-life complicated composite structures. Author

N87-18866*# Georgia Inst. of Tech., Atlanta.

OPTIMIZATION OF SHALLOW ARCHES AGAINST INSTABILITY USING SENSITIVITY DERIVATIVES

Manohar P. Kamat *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 167-175 (For primary document see N87-18855 11-39)

(Grant NSF ECE-85-96016)

Avail: NTIS HC A16/MF A01 CSCL 20K

The author discusses the problem of optimization of shallow frame structures which involve a coupling of axial and bending responses. A shallow arch of a given shape and of given weight is optimized such that its limit point load is maximized. The cross-sectional area, A(x) and the moment of inertia, I(x) of the arch obey the relationship I(x) = rho [A(x)] sup n, n = 1,2,3 and rho is a specified constant. Analysis of the arch for its limit point calculation involves a geometric nonlinear analysis which is performed using a corotational formulation. The optimization is carried out using a second-order projected Lagrangian algorithm and the sensitivity derivatives of the critical load parameter with respect to the areas of the finite elements of the arch are calculated using implicit differentation. Results are presented for an arch of a specified rise to span ratio under two different loadings and the limitations of the approach for the intermediate rise arches are addressed. Author

N87-18867*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.

SURVEY OF METHODS FOR CALCULATING SENSITIVITY OF GENERAL EIGENPROBLEMS c64

Durbha V. Murthy and Raphael T. Haftka *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 177-196 (For primary document see N87-18855 11-39)

Avail: NTIS HC A16/MF A01 CSCL 12A

A survey of methods for sensitivity analysis of the algebraic eigenvalue problem for non-Hermitian matrices is presented. In addition, a modification of one method based on a better normalizing condition is proposed. Methods are classified as Direct or Adjoint and are evaluated for efficiency. Operation counts are presented in terms of matrix size, number of design variables and number of eigenvalues and eigenvectors of interest. The effect of the sparsity of the matrix and its derivatives is also considered, and typical solution times are given. General guidelines are established for the selection of the most efficient method. Author

N87-18868*# Bridgeport Univ., Conn.

MODAL SENSITIVITY FOR STRUCTURAL SYSTEMS WITH REPEATED FREQUENCIES

I. U. Ojalvo *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 197-213 (For primary document see N87-18855 11-39)

Avail: NTIS HC A16/MF A01 CSCL 20K

Repeated or closely packed modal frequencies are common physical occurrences for vibrating structures which are complex or possess multi-planes of symmetry. The computation of the sensitivity to structural modifications for these frequencies and mode shapes is made difficult by the fact that the mode shapes are not unique, since any linear combination of eigenvectors corresponding to a repeated eigenvalue is also an eigenvector. The work of Chen and Pan is extended, who used modal expansion techniques for accommodating the sensitivity analysis of structures with repeated eigenvalues. Starting with a discussion of the physical significance of sensitivity analysis for repeated frequency modes, a derivation is presented of the governing equations for the derivatives of a repeated eigenvalue. This is followed with a small example to illustrate the results. An efficient computation procedure, based upon an expansion of Nelson's ideas for large banded systems, is then proposed for systems with repeated or closely spaced eigenvalues. Author

N87-18869*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SENSITIVITY DERIVATIVES AND OPTIMIZATION OF NODAL POINT LOCATIONS FOR VIBRATION REDUCTION
Jocelyn I. Pritchard, Howard M. Adelman, and Raphael T. Haftka (Virginia Polytechnic Inst. and State Univ., Blacksburg) *In its* Sensitivity Analysis in Engineering Feb. 1987 p 215-231 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 20K

A method is developed for sensitivity analysis and optimization of nodal point 'ocations in connection with vibration reduction. A straightforward derivation of the expression for the derivative of nodal locations is given, and the role of the derivative in assessing design trends is demonstrated. An optimization process is developed which uses added lumped masses on the structure as design variables to move the node to a preselected location; for example, where low response amplitude is required or to a point which makes the mode shape nearly orthogonal to the force distribution, thereby minimizing the generalized force. The optimization formulation leads to values for added masses that adjust a nodal location while minimizing the total amount of added mass required to do so. As an example, the node of the second mode of a cantilever box beam is relocated to coincide with the centroid of a prescribed force distribution, thereby reducing the generalized force substantially without adding excessive mass. A comparison with an optimization formulation that directly minimizes the generalized force indicates that nodal placement gives essentially a minimum generalized force when the node is appropriately placed. Author

N87-18870*# Texas Univ., Arlington. Dept. of Mechanical Engineering.
ON COMPUTING EIGENSOLUTION SENSITIVITY DATA USING FREE VIBRATION SOLUTIONS
B. P. Wang *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 233-245 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 20K

A simplified method of computing eigensolution sensitivity derivatives in structural dynamics is developed. It is shown that if the elements of stiffness and mass matrices associated with a design variable are homogeneous functions of that design variable, then eigenvalue derivatives can be computed from element strain and kinetic energies. Furthermore, if cross-mode energies are known, eigensolution derivatives of modified systems can be computed approximately using assume mode reanalysis formulation. A ten bar truss example is used to illustrate the present formulations. Author

N87-18871*# PRC Kentron, Inc., Hampton, Va. Aerospace Technologies Div.
APPLICATION OF A SYSTEM MODIFICATION TECHNIQUE TO DYNAMIC TUNING OF A SPINNING ROTOR BLADE
C. V. Spain *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 247-261 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 20K

An important consideration in the development of modern helicopters is the vibratory response of the main rotor blade. One way to minimize vibration levels is to ensure that natural frequencies of the spinning main rotor blade are well removed from integer multiples of the rotor speed. A technique for dynamically tuning a finite-element model of a rotor blade to accomplish that end is demonstrated. A brief overview is given of the general purpose finite element system known as Engineering Analysis Language (EAL) which was used in this work. A description of the EAL System Modification (SM) processor is then given along with an explanation of special algorithms developed to be used in conjunction with SM. Finally, this technique is demonstrated by dynamically tuning a model of an advanced composite rotor blade. E.R.

N87-18872*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
NUMERICAL STUDIES OF THE THERMAL DESIGN SENSITIVITY CALCULATION FOR A REACTION-DIFFUSION SYSTEM WITH DISCONTINUOUS DERIVATIVES c24
Jean W. Hou and Jeen S. Sheen *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 263-283 (For primary document see N87-18855 11-39)
(Grant NAG1-561)
Avail: NTIS HC A16/MF A01 CSCL 11D

The aim of this study is to find a reliable numerical algorithm to calculate thermal design sensitivities of a transient problem with discontinuous derivatives. The thermal system of interest is a transient heat conduction problem related to the curing process of a composite laminate. A logical function which can smoothly approximate the discontinuity is introduced to modify the system equation. Two commonly used methods, the adjoint variable method and the direct differentiation method, are then applied to find the design derivatives of the modified system. The comparisons of numerical results obtained by these two methods demonstrate that the direct differentiation method is a better choice to be used in calculating thermal design sensitivity. Author

N87-18873*# Kyoto Univ. (Japan). Dept. of Precision Engineering.
APPLICATION OF DESIGN SENSITIVITY ANALYSIS FOR GREATER IMPROVEMENT ON MACHINE STRUCTURAL DYNAMICS
Masataka Yoshimura *In* NASA. Langley Reserach Center Sensitivity Analysis in Engineering Feb. 1987 p 285-298 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 20K

Methodologies are presented for greatly improving machine structural dynamics by using design sensitivity analyses and evaluative parameters. First, design sensitivity coefficients and evaluative parameters of structural dynamics are described. Next, the relations between the design sensitivity coefficients and the evaluative parameters are clarified. Then, design improvement procedures of structural dynamics are proposed for the following three cases: (1) addition of elastic structural members, (2) addition of mass elements, and (3) substantial charges of joint design variables. Cases (1) and (2) correspond to the changes of the initial framework or configuration, and (3) corresponds to the alteration of poor initial design variables. Finally, numerical examples are given for demonstrating the availability of the methods proposed. Author

N87-18874*# PRC Kentron, Inc., Hampton, Va.
DESIGN SENSITIVITY ANALYSIS OF ROTORCRAFT AIRFRAME STRUCTURES FOR VIBRATION REDUCTION
T. Sreekanta Murthy *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 299-318 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 20K

Optimization of rotorcraft structures for vibration reduction was studied. The objective of this study is to develop practical computational procedures for structural optimization of airframes subject to steady-state vibration response constraints. One of the key elements of any such computational procedure is design sensitivity analysis. A method for design sensitivity analysis of airframes under vibration response constraints is presented. The mathematical formulation of the method and its implementation as a new solution sequence in MSC/NASTRAN are described. The results of the application of the method to a simple finite element stick model of the AH-1G helicopter airframe are presented and discussed. Selection of design variables that are most likely to bring about changes in the response at specified locations in the airframe is based on consideration of forced response strain energy. Sensitivity coefficients are determined for the selected design variable set. Constraints on the natural frequencies are also included in addition to the constraints on the steady-state response. Sensitivity coefficients for these constraints are determined. Results of the analysis and insights gained in applying the

method to the airframe model are discussed. The general nature of future work to be conducted is described. Author

N87-18875*# Howard Univ., Washington, D. C.
ON SINGULAR CASES IN THE DESIGN DERIVATIVE OF GREEN'S FUNCTIONAL
Robert Reiss *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 319-328 (For primary document see N87-18855 11-39)
(Grant NAG1-383)
Avail: NTIS HC A16/MF A01 CSCL 20K

The author's prior development of a general abstract representation for the design sensitivities of Green's functional for linear structural systems is extended to the case where the structural stiffness vanishes at an internal location. This situation often occurs in the optimal design of structures. Most optimality criteria require that optimally designed beams be statically determinate. For clamped-pinned beams, for example, this is possible only if the flexural stiffness vanishes at some intermediate location. The Green's function for such structures depends upon the stiffness and the location where it vanishes. A precise representation for Green's function's sensitivity to the location of vanishing stiffness is presented for beams and axisymmetric plates. Author

N87-18876*# Iowa Univ., Iowa City.
ON 3-D MODELING AND AUTOMATIC REGRIDDING IN SHAPE DESIGN SENSITIVITY ANALYSIS
Kyung K. Choi and Tse-Min Yao *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 329-345 (For primary document see N87-18855 11-39)
(Grant NAG1-215)
Avail: NTIS HC A16/MF A01 CSCL 20K

The material derivative idea of continuum mechanics and the adjoint variable method of design sensitivity analysis are used to obtain a computable expression for the effect of shape variations on measures of structural performance of three-dimensional elastic solids. Author

N87-18877*# General Motors Research Labs., Warren, Mich.
ACCURACY OF THE DOMAIN METHOD FOR THE MATERIAL DERIVATIVE APPROACH TO SHAPE DESIGN SENSITIVITIES
R. J. Yang and M. E. Botkin *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 347-356 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 20K

Numerical accuracy for the boundary and domain methods of the material derivative approach to shape design sensitivities is investigated through the use of mesh refinement. The results show that the domain method is generally more accurate than the boundary method, using the finite element technique. It is also shown that the domain method is equivalent, under certain assumptions, to the implicit differentiation approach not only theoretically but also numerically. Author

N87-18878*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SENSITIVITY ANALYSIS FOR LARGE-SCALE PROBLEMS
Ahmed K. Noor and Sandra L. Whitworth *In its* Sensitivity Analysis in Engineering Feb. 1987 p 357-374 Prepared in cooperation with George Washington Univ., Washington, D.C. (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 20K

The development of efficient techniques for calculating sensitivity derivatives is studied. The objective is to present a computational procedure for calculating sensitivity derivatives as part of performing structural reanalysis for large-scale problems. The scope is limited to framed type structures. Both linear static analysis and free-vibration eigenvalue problems are considered. Author

N87-18879*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPTIMIZATION PROCEDURE TO CONTROL THE COUPLING OF VIBRATION MODES IN FLEXIBLE SPACE STRUCTURES
Joanne L. Walsh Feb. 1987 12 p Proposed for presentation at the 28th AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, Monterey, Calif., 6-8 Apr. 1987
(NASA-TM-89115; NAS 1.15:89115) Avail: NTIS HC A02/MF A01 CSCL 20K

As spacecraft structural concepts increase in size and flexibility, the vibration frequencies become more closely-spaced. The identification and control of such closely-spaced frequencies present a significant challenge. To validate system identification and control methods prior to actual flight, simpler space structures will be flown. To challenge the above technologies, it will be necessary to design these structures with closely-spaced or coupled vibration modes. Thus, there exists a need to develop a systematic method to design a structure which has closely-spaced vibration frequencies. This paper describes an optimization procedure which is used to design a large flexible structure to have closely-spaced vibration frequencies. The procedure uses a general-purpose finite element analysis program for the vibration and sensitivity analyses and a general-purpose optimization program. Results are presented from two studies. The first study uses a detailed model of a large flexible structure to design a structure with one pair of closely-spaced frequencies. The second study uses a simple equivalent beam model of a large flexible structure to obtain a design with two pairs of closely-spaced frequencies. Author

N87-18880*# Catholic Univ. of America, Washington, D.C. Dept. of Mechanical Engineering.
OPTIMUM VIBRATION CONTROL OF FLEXIBLE BEAMS BY PIEZO-ELECTRIC ACTUATORS
A. Baz and S. Poh Mar. 1987 71 p
(Grant NAG5-250; NASA Order 30429-D)
(NASA-CR-180209; NAS 1.26:180209) Avail: NTIS HC A04/MF A01 CSCL 20K

The utilization of piezoelectric actuators in controlling the structural vibrations of flexible beams is examined. A Modified Independent Modal Space Control (MIMSC) method is devised to enable the selection of the optimal location, control gains and excitation voltage of the piezoelectric actuators in a way that would minimize the amplitudes of vibrations of beams to which these actuators are bonded, as well as the input control energy necessary to suppress these vibrations. The developed method accounts for the effects that the piezoelectric actuators have on changing the elastic and inertial properties of the flexible beams. Numerical examples are presented to illustrate the application of the developed MIMSC method in minimizing the structural vibrations of beams of different materials when subjected to different loading and end conditions using ceramic or polymeric piezoelectric actuators. The obtained results emphasize the importance of the devised method in designing more realistic active control systems for flexible beams, in particular, and large flexible structures in general. Author

N87-18881*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECTS OF CRACK SURFACE FRICTION AND ROUGHNESS ON CRACK TIP STRESS FIELDS
Roberto Ballarini (Case Western Reserve Univ., Cleveland, Ohio) and Michael E. Plesha (Wisconsin Univ., Madison) Feb. 1987 19 p
(Contract NCC3-46; NASA Work Order C-99066-G; Grant DAAL03-86-K-0134)
(NASA-TM-88976; ICOMP-87-1; E-3445; NAS 1.15:88976) Avail: NTIS HC A02/MF A01 CSCL 20K

A model is presented which can be used to incorporate the effects of friction and tortuosity along crack surfaces through a constitutive law applied to the interface between opposing crack surfaces. The problem of a crack with a saw-tooth surface in an infinite medium subjected to a far-field shear stress is solved and the ratios of Mode-I stress intensity to Mode-II stress intensity are calculated for various coefficients of friction and material properties.

The results show that tortuosity and friction lead to an increase in fracture loads and alter the direction of crack propagation. Author

N87-18882*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FATIGUE FAILURE OF REGENERATOR SCREENS IN A HIGH FREQUENCY STIRLING ENGINE
David R. Hull, Donald L. Alger, Thomas J. Moore, and Coulson M. Scheuermann Mar. 1987 22 p
(NASA-TM-88974; E-3443; NAS 1.15:88974) Avail: NTIS HC A02/MF A01 CSCL 10B

Failure of Stirling Space Power Demonstrator Engine (SPDE) regenerator screens was investigated. After several hours of operation the SPDE was shut down for inspection and on removing the regenerator screens, debris of unknown origin was discovered along with considerable cracking of the screens in localized areas. Metallurgical analysis of the debris determined it to be cracked-off-deformed pieces of the 41 micron thickness Type 304 stainless steel wire screen. Scanning electron microscopy of the cracked screens revealed failures occurring at wire crossovers and fatigue striations on the fracture surface of the wires. Thus, the screen failure can be characterized as a fatigue failure of the wires. The crossovers were determined to contain a 30 percent reduction in wire thickness and a highly worked microstructure occurring from the manufacturing process of the wire screens. Later it was found that reduction in wire thickness occurred because the screen fabricator had subjected it to a light cold-roll process after weaving. Installation of this screen left a clearance in the regenerator allowing the screens to move. The combined effects of the reduction in wire thickness, stress concentration (caused by screen movement), and highly worked microstructure at the wire crossovers led to the fatigue failure of the screens. Author

N87-18883*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A COMPARATIVE STUDY OF SOME DYNAMIC STALL MODELS
T. S. R. Reddy (Toledo Univ., Ohio) and K. R. V. Kaza Mar. 1987 79 p
(NASA-TM-88917; E-3342; NAS 1.15:88917) Avail: NTIS HC A05/MF A01 CSCL 20K

Three semi-empirical aerodynamic stall models are compared with respect to their lift and moment hysteresis loop prediction, limit cycle behavior, easy implementation, and feasibility in developing the parameters required for stall flutter prediction of advanced turbines. For the comparison of aeroelastic response prediction including stall, a typical section model and a plate structural model are considered. The response analysis includes both plunging and pitching motions of the blades. In model A, a correction to the angle of attack is applied when the angle of attack exceeds the static stall angle. In model B, a synthesis procedure is used for angles of attack above static stall angles and the time history effects are accounted through the Wagner function. In both models the life and moment coefficients for angle of attack below stall are obtained from tabular data for a given Mach number and angle of attack. In model C, referred to an the ONERA model, the life and moment coefficients are given in the form of two differential equations, one for angles below stall, and the other for angles above stall. The parameters of those equations are nonlinear functions of the angle of attack. Author

N87-18884*# National Academy of Sciences - National Research Council, Washington, D. C. Systems Dynamics Lab.
THE EFFECT OF A SMALL INITIAL CURVATURE ON THE FREE VIBRATION OF CLAMPED, RECTANGULAR PLATES Interim Report
A. A. Adeniji-Fashola and A. A. Oyediran (Lagos Univ., Nigeria) Oct. 1986 24 p
(Contract NASw-3458)
(NASA-CR-178964; NAS 1.26:178964) Avail: NTIS HC A02/MF A01 CSCL 20K

An analytical method of obtaining the natural frequencies and mode shapes of clamped, rectangular plates having a small initial curvature is presented. Specifically, the singular perturbation technique is used to reduce the fourth-order plate vibration problem to the simpler membrane problem with modified boundary conditions that account for the bending effects. The eigenfrequencies for plates with inverse aspect ratios varying between 0.1 and 1.0 and for the dimensionless normal prestress between 0.1 and 1.0 have been presented for values of epsilon, the normalized bending rigidity, ranging between 0.0010 and 0.2500. It is established that a small initial curvature has no effect on the frequency of vibration of the plate. However, its effect is manifested in the eigenmodes. Author

N87-18885# Naval Sea Systems Command, Washington, D.C. Deck Systems Branch.
SNYTHETIC LINE SNAPBACK
George Prentice and Andrew Miles Mar. 1986 12 p Presented at the 23rd Annual Technical Symposium, Washington, D.C., 1986
(AD-A174041) Avail: NTIS HC A02/MF A01 CSCL 13/12

When a long thin tensile member is loaded until it breaks, it will snap back in the direction of pull. It matters not if that tensile member is made of rubber, synthetic fiber, wire or glass; it is going to snap back. The only variable in this phenomenon is the speed that it will snap back. Synthetic fiber rope snaps back at about 700 feet/sec; wire rope at about 450 feet/sec. Therefore, both ropes are deadly to anyone standing near them when a failure occurs. In the early 1980's several synthetic fiber ropes did fail. In one nine month period three sailors were killed and four had one or both legs cut off. This report outlines the approach taken by NAVSEA to reduce the number of accidents resulting from synthetic line snap back. The most effective short term solution is to make personnel aware of the dangers invoived in linehandling and the proper procedure for handling the lines to avoid injury due to snapback. For long term solution to the problem, the development of a low snapback line is the only sure way to go. A Kevlar-Nylon combination has been tested in the laboratory and will shortly undergo field testing on a U.S. Navy ship. GRA

N87-18886# Iowa Univ., Iowa City. Optimal Design Lab.
COMPUTER-AIDED STRUCTURAL DESIGN OPTIMIZATION USING A DATABASE MANAGEMENT SYSTEM Interim Technical Report, Oct. 1984 - Sep. 1985
T. SreekantaMurthy and Jasbir S. Arora 30 Sep. 1986 320 p
(Grant AF-AFOSR-0322-82)
(AD-A174450; ODL-85-17; AFOSR-86-2069TR) Avail: NTIS HC A14/MF A01 CSCL 09/2

Finite element based optimal structural design methods and computer science methods are integrated into a computer-based system containing database, program library and man-machine communication link. Emphasis is on database management concepts for structural design. Important components required to build a computer-aided structural design system are described. A number of database management concepts, i.e., hierarchical, network and relational data models, conceptual, internal and external view of data organization, normalization of data, and global and local database are discussed with reference to structural design data. A methodology to design a database is proposed. Three levels of data: organization-conceptual, internal and external are suggested. A methodology to construct a numerical data model is described. This model supports data of various types of large matrices such as banded, skyline and hypermatrices. Requirements of database management system and components needed to develop it are discussed. Language requirements to permit a good communication link between designer and computer are formulated. MIDAS, a database management system is implemented for use in structural design applications. GRA

N87-18887# Ballistic Research Labs., Aberdeen Proving Ground, Md.
QUASI-STATIC COMPRESSION AND TENSILE STRESS-STRAIN CURVES, TANTALUM-10% TUNGSTEN AND 300 GRADE MAR AGING STEEL Final Memorandum Report
Ralph F. Benck and Graham F. Silsby May 1986 42 p

(AD-A174685; BRL-MR-3521) Avail: NTIS HC A03/MF A01 CSCL 19/1

The results of quasi-static compression and tension tests of tantalum -10% tungsten alloy and Vascomax 300 CVM 300 trade maraging steel are presented. Young's modulus, Poisson's ratio, and yield strength and ultimate strength were determined at test temperatures of 23.9 C. Results provide engineering properties documentation for materials used in several terminal ballistic tests. GRA

N87-18888# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Adhesion Science.

THE DEVELOPMENT OF A MODIFIED DOUBLE CANTILEVER BEAM SPECIMEN FOR MEASURING THE FRACTURE ENERGY OF RUBBER TO METAL BONDS Interim Report, Apr. 1985 - Apr. 1986

Didier R. Lefebvre and David A. Dillard 20 Nov. 1986 30 p

(Contract N00014-82-K-0185)

(AD-A174832; CAS/ESM-86-3; VPI-E-86-26) Avail: NTIS HC A03/MF A01 CSCL 20/11

Rubber to metal bonds are important in a variety of automotive, tire, and marine applications. A new technique is discussed for measuring the strain energy release rates of these adhesively bonded joints in the presence of harsh environments. Guidelines for design and applications are given. GRA

N87-18889# Naval Research Lab., Washington, D. C.

MASSES OF NORMAL MODES FOR STRUCTURES WITH MULTIPLE SUPPORTS

R. L. Bort 14 Nov. 1986 34 p

(AD-A175974; NRL-MR-5877) Avail: NTIS HC A03/MF A01 CSCL 20/11

The Navy's dynamic design-analysis method gives shock response of equipment as a function of the frequencies and masses of its normal modes of vibration. The report shows how the definition of modal mass can be extended to the case in which different shocks are applied to the several supports for an item. Two examples for items that were subjected to impacts by torpedoes show that the extended definition reduces the predicted severity of shock response. GRA

N87-18890# Brown Univ., Providence, R. I. Div. of Engineering.

CRACK INITIATION AND GROWTH UNDER FAR-FIELD CYCLIC COMPRESSION: THEORY, EXPERIMENTS AND APPLICATIONS

S. Suresh, T. Christman, and C. Bull 1986 29 p Presented at the International Symposium on Short Fatigue Cracks, Santa Barbara, Calif., 5 Jan. 1986

(Contract DE-FG02-84ER-45167)

(DE86-015670; DOE/ER-45167/5; CONF-860185-1) Avail: NTIS HC A03/MF A01

The application of cyclic compressive loads can result in the propagation of fatigue cracks from stress concentrations (i.e., notch, void, etc.). Such cracks, initiated under the influence of residual tensile stresses in the vicinity of the stress concentration, generally grow at a progressively decreasing rate before arresting completely. Although the occurrence of this phenomenon had long been recognized, very little is known about the mechanics and mechanisms of crack advance under imposed cyclic compressive loads. In this paper, we examine the influence of stress state, crack-tip plasticity, load range and microstructure on the characteristics of crack initiation and (short crack) growth under fully compressive far-field cyclic loads. Some important applications of the phenomenon of crack initiation under far-field cyclic compression to the study of long and short (tensile) fatigue cracks are discussed. It is demonstrated that this phenomenon offers a useful tool for quickly obtaining estimates of fatigue crack growth threshold while minimizing some of the uncertainties inherent in the conventional (load-shedding) procedures. Furthermore, the initiation of cracks from notches subject to remote compression is shown to offer some valuable insights into the growth and closure behavior of physically-small (tensile) cracks. The significance and limitations of the compression method are described. DOE

N87-18891# Sandia National Labs., Albuquerque, N. Mex. Parachute Systems Div.

NEW SOLUTION METHOD FOR STEADY-STATE CANOPY STRUCTURAL LOADS

W. D. Sundberg Aug. 1986 25 p Presented at the 9th AIAA Aerodynamic Decelerator and Balloon Technology Conference, Albuquerque, N. Mex., 7 Oct. 1986

(Contract DE-AC04-76DP-00789)

(DE86-014294; SAND-86-0624C; CONF-861050-4) Avail: NTIS HC A02/MF A01

A new computer code has been written to perform structural analysis canopies. Although an existing code, CANO, has been available, the new code has better convergence reliability, is more understandably written, and is easier to use. The equations have been reformulated for the new solution method. The new code assumes a symmetric canopy, a steady-state condition, and no strength in the vertical direction. It computes the inflated shape, loads in the horizontal members, radial members, vent lines, and suspension lines, and total drag. Constructed geometry, material properties, dynamic pressure, and pressure distribution are required as input. DOE

N87-18892# Sandia National Labs., Albuquerque, N. Mex. Experimental Mechanics Dept.

EXPERIMENTAL DETERMINATION OF THE DYNAMIC FORCES ACTING ON NON-RIGID BODIES

D. L. Gregory, T. G. Priddy, and D. O. Smallwood 1986 12 p Presented at the Society of Automotive Engineers Aerospace Technology Conference and Exposition, Los Angeles, Calif., 13 Oct. 1986

(Contract DE-AC04-76DP-00789)

(DE86-014726; SAND-86-0491C; CONF-8610129-1) Avail: NTIS HC A02/MF A01

This method uses a sum of weighted acceleration signals to experimentally predict the external force which excites a mechanical system. The method is shown to yield excellent results in experiments conducted on a mass-loaded, free-free, steel beam. Random vibration was used to excite the beam in preliminary tests conducted to determine the optimal distribution of the weighting factors which can be associated with an equivalent mass at each accelerometer location. The system dynamic degrees of freedom (reflecting an upper frequency limit) are directly related to the number of independent acceleration measurements. Follow-on experiments demonstrate how the technique can be used to correctly predict an unknown force-time signature. Alternate techniques for determining the weighting factors are discussed. The technique does not appear to be overly sensitive to variations in the mass matrix. DOE

N87-18893# Ames Lab., Iowa.

INFERENCE OF STRESS AND TEXTURE FROM THE VELOCITIES OF ULTRASONIC PLATE MODES Ph.D. Thesis

S. S. Lee Aug. 1986 84 p

(Contract W-7405-eng-82)

(DE86-015775; IS-T-1269) Avail: NTIS HC A05/MF A01

An ultrasonic approach is proposed to independently characterize stress and texture in rolled metal plate. The approach is based on the theory for the angular dependence of the ultrasonic wave velocity in a symmetry plane of an orthorhombic, stressed material. The theory for the angular dependence of the velocities reveals terms with two-fold, four-fold, and six-fold symmetry, which are utilized in the separation of the stress and texture contributions. The experimental implementation has utilized measurements of the velocities of SH/sub o/ and S/sub o/ guided wave modes in thin plates. These modes are generated and detected by electromagnetic acoustic transducers. The ability to determine the directions and differences in magnitudes of principal stresses from the SH/sub o/ data is described. From a combination of the SH/sub o/ and S/sub o/ data, a procedure is proposed for determining the coefficients W sub 400, W sub 420, and W sub 440 in terms of an expansion to fourth order of the crystallite orientation distribution function in terms of generalized Legendre functions. Experimental results are presented for the cases of

aluminum, 304 stainless steel, and copper. The results fully confirm the proposed stress measurement technique. Predictions of W sub 440 are also in good agreement with independent measurements based on X-ray pole figures. Refinements in the X-ray techniques are required before the accuracies of the predictions of W sub 400 and W sub 420 can be fully assessed. DOE

N87-18894# Sandia National Labs., Albuquerque, N. Mex.
FRAGMENTATION OF RAPIDLY EXPANDING JETS AND SHEETS
D. E. Grady 1986 11 p Presented at the Hypervelocity Impact Symposium, San Antonio, Tex., 21 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE86-014143; SAND-85-2451C; CONF-861091-4) Avail: NTIS HC A02/MF A01

A common consequence of hypervelocity impact phenomena, or other intense loading process, is the creation of rapidly expanding hydrodynamic jets or sheets. Theoretical results are derived for the time to failure and fragment size associated with the catastrophic breakup of jets and sheets. Physical effects leading to the enhanced ductility of materials during dynamic expansion are discussed. Theoretical results are compared with impact plumes and shaped-charge jets. DOE

N87-18895# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
DIGITAL ACQUISITION AND ANALYSIS OF ACOUSTIC EMISSION SIGNALS FOR CRACK SITE INITIATION STUDIES
B. A. Barna, J. A. Johnson, and R. T. Allemeier Aug. 1986 8 p Presented at the Conference on Review of Progress in Quantitative NDE, San Diego, Calif., 3 Aug. 1986
(Contract DE-AC07-76ID-01570)
(DE87-000436; EGG-M-11086; CONF-860856-5) Avail: NTIS HC A02/MF A01

In the study of elastic-plastic fracture mechanisms it is necessary to determine accurately the time and location history of crack initiation and to discriminate between the fracture mechanisms of ductile and brittle rupture. In order to accomplish this, a real-time digital acquisition system for analysis of acoustic emissions has been configured, and some preliminary results are described in this paper. The goals for this system are to locate crack initiation sites with an accuracy of 200 microns or better and to respond to events separated in time by less than 100 ms. DOE

N87-18896# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
CORROSION FATIGUE OF SMALL CRACKS: MECHANICS AND CHEMISTRY Progress Report, 1 Sep. 1985 - 31 Aug. 1986
R. P. Wei 29 Sep. 1986 24 p
(Contract DE-FG02-84ER-45138)
(DE87-000634; DOE/ER-45138/T1) Avail: NTIS HC A02/MF A01

During this period, principal efforts were directed to the following areas: further calibration of the ac potential system for monitoring small crack growth, measurements of small crack growth in a NiCrMoV steel, measurements of small crack growth in an annealed 304 stainless steel, measurement of electrochemical reaction kinetics for NiCrMoV and 304 stainless steels, and correlation between the kinetics of electrochemical reactions and corrosion fatigue crack growth response. DOE

N87-18897# Sandia National Labs., Albuquerque, N. Mex.
SYSTEM CHARACTERIZATION IN NONLINEAR RANDOM VIBRATION
T. L. Paez and D. L. Gregory 1986 8 p Presented at the 57th Shock and Vibration Symposium, New Orleans, La., 14 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE87-000979; SAND-86-1174C; CONF-8610140-4) Avail: NTIS HC A02/MF A01

Linear structural models are frequently used for structural system characterization and analysis. In most situations they can provide satisfactory results, but under some circumstances they are insufficient for system definition. The present investigation proposes a model for nonlinear structure characterization, and demonstrates how the functions describing the model can be identified using a random vibration experiment. Further, it is shown that the model is sufficient to completely characterize the stationary random vibration response of a structure that has a harmonic frequency generating form of nonlinearity. An analytical example is presented to demonstrate the plausibility of the model. DOE

N87-18898# Lawrence Livermore National Lab., Calif.
ANALOGY BETWEEN DISLOCATION KINETICS AND MICROCRACK KINETICS ACROSS SHOCK FRONTS
R. B. Stout May 1986 9 p Presented at the 2nd International Conference on Constitutive Laws for Engineering Materials, Tucson, Ariz., 5 Jan. 1987
(Contract W-7405-eng-48)
(DE86-010970; UCRL-93993; CONF-870103-1) Avail: NTIS HC A02/MF A01

An analysis for propagating spatial discontinuities of microcrack density, mass density, momentum density, and energy density is described in terms of an analogy between dislocations and microcracks. Because of the statistical, kinematic, and energetic analogies, previously derived discontinuity conditions involving dislocation kinetics across shocks provide the necessary mathematical formalism and physical concepts for analog discontinuity conditions involving microcrack kinetics. DOE

N87-18899# California Univ., Davis. Dept. of Mechanical Engineering.
DEFORMATION MECHANISMS AND FAILURE MODES IN SUPERPLASTICITY Final Summary Report
A. K. Mukherjee 26 Mar. 1986 8 p
(Contract DE-AS03-79ER-10508)
(DE87-001871; DOE/ER-10508/T3) Avail: NTIS HC A02/MF A01

Deformation mechanisms were investigated in the following alloys: Zn-22 Al eutectoid, a copper-based alloy, IN744 microduplex stainless steel, and 7475-T6 aluminum alloy. DOE

N87-18900# Los Alamos National Lab., N. Mex.
FINITE STRAIN MEASURES
W. A. Cook Dec. 1986 84 p
(Contract W-7405-eng-36)
(DE87-003660; LA-10674-MS) Avail: NTIS HC A05/MF A01

The first in a series of reports on nonlinear mechanics, this report derives, discusses, and illustrates finite strain measures. Included are deformations for configurations (or states) of a deforming body, coordinate systems to describe the configurations, and descriptions (approaches used to describe translation, rotation, and deformation). Green and Almansi strains are derived for the corotational and codeformational descriptions. Solutions of deformation example problems and comparison of the results indicate that for these two strains: (1) in the case of a rectangular body with uniform extensions, they are quite different; (2) in the case of a rectangular body in simple shear, their two shearing strains are identical and their nonzero normal strains have identical magnitudes but opposite signs; (3) in the case of a cylinder, inflation and extension correspond to uniform extension whereas torsion corresponds to simple shear; and (4) in the case of longitudinal to circular beam deformation, they can be compared with uniform extension when stretch is constant in each direction. Therefore, solution of these example problems indicates that differences between Green and Almansi strains are in the normal strains and that their shearing strains are identical when differences in the normal strains are eliminated. Signorini and blank (unnamed) strains are also defined; and Green, Almansi, Signorini, blank, Biot, and logarithmic strains are all compared for a uniform extension problem. All strain measures lead to correct solutions in nonlinear mechanics when problems are formulated correctly and the constitutive relations are accurate. DOE

N87-18901# Kaiserslautern Univ. (West Germany). Fachbereich Maschinenwesen.

INVESTIGATION OF TWO-DIMENSIONAL ELASTODYNAMIC STRESS CONCENTRATION AND CRACK PROBLEMS Ph.D. Thesis [UNTERSUCHUNG ZWEIDIMENSIONALER ELASTODYNAMISCHER SPANNUNGSKONZENTRATIONS- UND RISSPROBLEME]
Werner Wilhelm Kraft 1986 156 p In GERMAN
(ETN-87-99012) Avail: NTIS HC A08/MF A01

The finite element (FE) program system FLADYN was developed for the treatment of two-dimensional elastic wave propagation problems. By the introduction of element-specific processors other elements can be integrated and FE-analyses can also be performed on small-memory computers. Element sizes and time steps can be varied within broad domains, allowing the treatment of complicated geometries. Two fracture-mechanics processors were developed for fracture-dynamics analyses. Dimensioning can be performed without extensive stress analysis. The evolution of the stress intensity factor and the dynamic increments of the stiffness matrix values can be determined. This allows the evaluation of possibly unstable crack propagation. ESA

N87-18902# Centre Technique des Industries Mecaniques, Senlis (France).
BOX BEAMS: STRESSES IN THE PANELS, CRITICAL BUCKLING LOAD, INFLUENCE OF BOUNDARY CONDITIONS Final Report [POUTRES CAISSON: CONTRAINTES DANS LES PANNEAUX, CHARGE CRITIQUE DE FLAMBEMENT, INFLUENCE DE CONDITIONS AUX LIMITES]
J. Magny Sep. 1985 58 p In FRENCH
(CETIM-14A251; ETN-87-99155) Avail: NTIS HC A04/MF A01

The CASTOR.SD buckling code was used to analyze stress distribution in the panels of box beams in accordance with German standards and European specifications. The Euler option of the code can be used to position stiffeners in the panels and to prove the acceptability of the structure when it is calculated as a whole, whereas more simplified analysis methods would reject the structure. ESA

N87-18903# National Bureau of Standards, Boulder, Colo. Fracture and Deformation Div.
FRACTURE MECHANICS CHARACTERIZATION OF CRACK ARREST AND REINITIATION IN TWO UNCONVENTIONAL SPECIMENS
T. Teramoto, D. T. Read, and R. B. King Jun. 1986 120 p Sponsored by ONR and Naval Ship Research and Development Center
(PB86-245743; NBSIR-85-3034) Avail: NTIS HC A06/MF A01 CSCL 20K

A simple elastic-plastic-fracture-mechanics-based model of crack propagation, arrest, re-initiation, and propagation is described. This model requires much less computing resources than dynamic, elastic-plastic finite element calculations, and allows estimates of applied J-integral, load, and crack mouth opening displacement during initial rapid crack propagation, re-initiation and repropagation. A comparison of the new model to other available models and to experimental results indicates that it can successfully reproduce the essential features of the behavior of specimens containing propagating cracks. GRA

N87-18904# Oak Ridge National Lab., Tenn. Heavy-Section Steel Technology Program.
APPLICATIONS OF ELASTIC-VISCOPLASTIC CONSTITUTIVE MODELS IN DYNAMIC ANALYSES OF CRACK RUN-ARREST EVENTS
B. R. Bass, C. E. Pugh, and C. E. Swindeman 1986 10 p Presented at conference
(Contract DE-AC05-84OR-21400)
(TI86-011786; CONF-8606138-1) Avail: NTIS HC A02/MF A01

Applications of nonlinear techniques to the first series of six HSST wide-plate crack-arrest tests that were performed are described. The experiments include crack initiations at low temperatures and relatively long (20 cm) cleavage propagation phases which are terminated by arrest in high-temperature regions. Crack arrests are then followed by ductile tearing events. Consequently, the crack-front regions are exposed to wide ranges of strain rates and temperatures. B.G.

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N87-18905*# Kansas Univ. Center for Research, Inc., Lawrence.
EXTERNAL CALIBRATION OF SIR-B IMAGERY WITH AREA-EXTENDED AND POINT TARGETS Final Report
M. C. Dobson (Michigan Univ., Ann Arbor), Fawwaz T. Ulaby, D. R. Brunfeldt (Applied Microwave Corp., Lawrence, Kans.), and D. N. Held (Jet Propulsion Lab., California Inst. of Tech., Pasadena) Sep. 1985 34 p
(Contract JPL-956921)
(NASA-CR-179951; NAS 1.26:179951) Avail: NTIS HC A03/MF A01 CSCL 05B

Data-takes on two ascending orbits of the Shuttle Imaging Radar-B (SIR-B) over an agricultural test site in west-central Illinois were used to establish end-to-end transfer functions for conversion of the digital numbers on the 8-bit image to values of the radar backscattering coefficient sigma sup 0 (sq m/sq. m) in dB. The transfer function for each data-take was defined by the SIR-B response to an array of six calibrated point targets of known radar cross-section (transponders) and to a large number of area-extended targets also with known radar cross-section as measured by externally calibrated, truck-mounted scatterometers. The radar cross-section of each transponder at the SIR-B center frequency was measured on an antenna range as a function of local angle of incidence. Two truck-mounted scatterometers observed 20 to 80 agricultural fields daily at 1.6 GHz with HH polarization and at azimuth viewing angles and incidence angles equivalent to those of the SIR-B. The form of the transfer function is completely defined by the SIR-B receiver and the incoherent averaging procedure incorporated into production of the standard SIR-B image product. Author

N87-18906*# National Aeronautics and Space Administration, Washington, D.C.
MODIS: MODERATE-RESOLUTION IMAGING SPECTROMETER. EARTH OBSERVING SYSTEM, VOLUME 2B
1986 72 p Original document contains color illustrations
(NASA-TM-89213; NAS 1.15:89213) Avail: NTIS HC A04/MF A01 CSCL 14B

The Moderate-Resolution Imaging Spectrometer (MODIS), as presently conceived, is a system of two imaging spectroradiometer components designed for the widest possible applicability to research tasks that require long-term (5 to 10 years), low-resolution (52 channels between 0.4 and 12.0 micrometers) data sets. The system described is preliminary and subject to scientific and technological review and modification, and it is anticipated that both will occur prior to selection of a final system configuration; however, the basic concept outlined is likely to remain unchanged. B.G.

N87-18907*# California Univ., Santa Barbara. Information Sciences Research Group.
REMOTE SENSING INFORMATION SCIENCES RESEARCH

GROUP, YEAR FOUR
John E. Estes, Terence Smith, and Jeffrey L. Star 1 Jan. 1987 140 p
(Grant NAGw-455)
(NASA-CR-180198; NAS 1.26:180198) Avail: NTIS HC A07/MF A01 CSCL 05B

The needs of the remote sensing research and application community which will be served by the Earth Observing System (EOS) and space station, including associated polar and co-orbiting platforms are examined. Research conducted was used to extend and expand existing remote sensing research activities in the areas of georeferenced information systems, machine assisted information extraction from image data, artificial intelligence, and vegetation analysis and modeling. Projects are discussed in detail. B.G.

N87-18908 Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
HOMOGENEOUS PLATE DEFORMATIONS ON A SPHERE AS MONITORED BY SATELLITE LASER RANGING (SLR) NETWORKS ANALYZED WITH THE MULTI-EPOCH METHOD Thesis
B. J. Duesmann 1986 184 p
(ETN-87-99221) Avail: NTIS HC A09

An expression between parameters describing the form of a satellite laser ranging network at different epochs and (spherical) parameters describing a matching deformation for each plate was derived. The deformation, the network, the measurements, and the reference coordinate system should fulfil the following conditions: all network sites are visited twice at least; the coordinates are given in orthonormal coordinate systems with corresponding covariance matrices; all network sites are known in one orthonormal reference coordinate system with a known absolute positioning; the deformation of a plate is small, homogeneous, and time-independent; and the size of each plate is limited. ESA

N87-18909*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NASA/JPL AIRCRAFT SAR OPERATIONS FOR 1984 AND 1985
T. W. Thompson, ed. 1 Nov. 1986 126 p Original contains color illustrations
(Contract NAS7-918)
(NASA-CR-180237; JPL-PUB-86-20; NAS 1.26:180237) Avail: NTIS HC A07/MF A01 CSCL 17I

The NASA/JPL aircraft synthetic aperture radar (SAR) was used to conduct major data acquisition expeditions in 1983 through 1985. Substantial improvements to the aircraft SAR were incorporated in 1981 through 1984 resulting in an imaging radar that could simultaneously record all four combinations of linear horizontal and vertical polarization (HH, HV, VH, VV) using computer control of the radar logic, gain setting, and other functions. Data were recorded on high-density digital tapes and processed on a general-purpose computer to produce 10-km square images with 10-m resolution. These digital images yield both the amplitude and phase of the four polarizations. All of the digital images produced so far are archived at the JPL Radar Data Center and are accessible via the Reference Notebook System of that facility. Sites observed in 1984 and 1985 included geological targets in the western United States, as well as agricultural and forestry sites in the Midwest and along the eastern coast. This aircraft radar was destroyed in the CV-990 fire at March Air Force Base on 17 July 1985. It is being rebuilt for flights in 1987 and will likely be operated in a mode similar to that described here. The data from 1984 and 1985 as well as those from future expeditions in 1987 and beyond will provide users with a valuable data base for the multifrequency, multipolarization Spaceborne Imaging Radar (SIR-C) scheduled for orbital operations in the early 1990's.Author

N87-18910*# Lunar and Planetary Inst., Houston, Tex.
THEMATIC MAPPER STUDIES OF CENTRAL ANDEAN VOLCANOES Progress Report
Peter W. Francis Jan. 1987 17 p
(Contract NAS5-28759)
(NASA-CR-180252; NAS 1.26:180252) Avail: NTIS HC A02/MF A01 CSCL 08K

A series of false color composite images covering the volcanic cordillera was written. Each image is 45 km (1536 x 1536 pixels) and was constructed using bands 7, 4, and 2 of the Thematic Mapper (TM) data. Approximately 100 images were prepared to date. A set of LANDSAT Multispectral Scanner (MSS) images was used in conjunction with the TM hardcopy to compile a computer data base of all volcanic structure in the Central Andean province. Over 500 individual structures were identified. About 75 major volcanoes were identified as active, or potentially active. A pilot study was begun combining Shuttle Imaging Radar (SIR) data with TM for a test area in north Chile and Bolivia. B.G.

N87-18911*# Arizona Univ., Tucson. Optical Sciences Center.
SPECTRORADIOMETRIC CALIBRATION OF THE THEMATIC MAPPER AND MULTISPECTRAL SCANNER SYSTEM Final Report, 1 Nov. 1982 - 30 Apr. 1986
Philip N. Slater and James M. Palmer Dec. 1986 228 p
(Contract NAS5-27382)
(NASA-CR-180248; NAS 1.26:180248) Avail: NTIS HC A11/MF A01 CSCL 14B

A list of personnel who have contributed to the program is provided. Sixteen publications and presentations are also listed. A preprint summarizing five in-flight absolute radiometric calibrations of the solar reflective bands of the LANDSAT-5 Thematic Mapper is presented. The 23 band calibrations made on the five dates show a 2.5% RMS variation from the mean as a percentage of the mean. A preprint is also presented that discusses the reflectance-based results of the above preprint. It proceeds to analyze and present results of a second, independent calibration method based on radiance measurements from a helicopter. Radiative transfer through the atmosphere, model atmospheres, the calibration methodology used at White Sands and the results of a sensitivity analysis of the reflectance-based approach is also discussed. Author

N87-18912*# Illinois Natural History Survey, Champaign. Section of Botany and Plant Pathology.
INTERPRETING FOREST AND GRASSLAND BIOME PRODUCTIVITY UTILIZING NESTED SCALES OF IMAGE RESOLUTION AND BIOGEOGRAPHICAL ANALYSIS Progress Report
Louis R. Iverson, Elizabeth A. Cook, Robin L. Graham, Jerry S. Olson, Thomas Frank, Ying Ke, Colin Treworgy, and Paul G. Risser 4 Feb. 1987 35 p Prepared in cooperation with Oak Ridge National Lab., Tenn.
(Contract NAS5-28781)
(NASA-CR-180213; TMWR-PR-3; NAS 1.26:180213; TS-BPP-1987-1) Avail: NTIS HC A03/MF A01 CSCL 05B

This report summarizes progress made in our investigation of forest productivity assessment using TM and other biogeographical data during the third six-month period of the grant. Data acquisition and methodology hurdles are largely complete. Four study areas for which the appropriate TM and ancillary data were available are currently being intensively analyzed. Significant relationships have been found on a site by site basis to suggest that forest productivity can be qualitatively assessed using TM band values and site characteristics. Perhaps the most promising results relate TM unsupervised classes to forest productivity, with enhancement from elevation data. During the final phases of the research, multi-temporal and regional comparisons of results will be addressed, as well as the predictability of forest productivity patterns over a large region using TM data and/or TM nested within AVHRR data. Author

N87-18913# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INVESTIGATION OF PHYSICS OF SYNTHETIC APERTURE RADAR IN OCEAN REMOTE SENSING TOWARD 84/86 FIELD EXPERIMENT. VOLUME 1: DATA SUMMARY AND EARLY RESULTS Interim Report, Sep. 1984 - May 1985
Omar H. Shemdin May 1986 160 p

(AD-A174197) Avail: NTIS HC A08/MF A01 CSCL 17/9

The mechanisms responsible for SAR imaging of the ocean surface are not adequately understood at present. Conflicting hypotheses have been proposed that remain without valid proof, because of lack of adequate data sets to test these hypotheses. The influence of environmental parameters has prevented extending relationships that were demonstrated under one set of conditions to another beyond the range used in formulating the relationships. GRA

N87-18914# Lawrence Livermore National Lab., Calif. Signal and Image Processing Research Group.

SOFTWARE CORRELATION OF SEASAT SAR DATA ON THE S-1 COMPUTER

P. Fitch and S. Correll Jul. 1986 91 p

(Contract W-7405-eng-48)

(DE86-016045; UCID-20807) Avail: NTIS HC A05/MF A01

The S-1 computer's high processing speeds and large computer memory can be utilized for efficient Synthetic Aperture Radar (SAR) algorithm development and implementation. System independent standard F77 FORTRAN is used to process raw data from the SEASAT satellite. The resulting software correlator is significantly easier to develop, debug, and maintain than previous systems which are hardware and/or memory bound. Current processing capabilities together with the machine independent source code represent a versatile test bed for new algorithm development in SAR and other related array processing technologies such as computerized tomography, aperture imaging, and synthetic aperture focusing techniques for ultrasonic testing. It is possible that the use of a network of S-1 uniprocessors will also provide the computing cycles necessary for real time SAR processing and analysis. DOE

N87-18915# Department of Energy, Morgantown, W. Va. Energy Technology Center.

PROCEEDINGS OF THE SECOND WORKSHOP ON REMOTE SENSING/LINEAMENT APPLICATIONS FOR ENERGY EXTRACTION

C. A. Komar, ed. Jul. 1986 143 p Symposium held at Morgantown, W. Va., 23 Apr. 1986

(DE86-006613; DOE/METC-86-6039; CONF-860244) Avail: NTIS HC A07/MF A01

The Second Workshop on Remote Sensing/Lineament Applications for Energy Extraction was held April 23 to 24, 1986, at the Ramada Inn in Morgantown, West Virginia, and was sponsored and hosted by the US Department of Energy (DOE), Office of Fossil Energy, Morgantown Energy Technology Center. This annual meeting provides a forum for the exchange of information and was attended by 82 individuals who represented industry, private consulting firms, and DOE. Nine papers were presented at the meeting; participants in a panel discussion and an open discussion reviewed and analyzed the information presented. The proceedings have been reproduced from camera-ready manuscripts furnished by the authors. The papers have not been refereed, nor have they been extensively edited. All papers have been processed for inclusion in the Energy Data Base. DOE

N87-18916# Los Alamos National Lab., N. Mex. Theoretical Div.

OFF-NADIR OPTICAL REMOTE SENSING FROM SATELLITES FOR VEGETATION IDENTIFICATION

S. A. W. Gerstl 30 May 1986 5 p Presented at the IGARSS '86 Symposium, Zurich, Switzerland, 8 Sep. 1986

(Contract W-7405-eng-36)

(DE86-012387; LA-UR-86-1927; CONF-860997-1) Avail: NTIS HC A02/MF A01

Today's satellite remote sensing systems rely heavily on spectral signatures for scene identification from nadir observations. We propose to use angular signatures as complementary scene identifiers when off-nadir sensing is possible. Specifically, the hot spot (Heiligenschein) of plant canopies is recognized as an atmosphere-invariant angular reflectance signature that carries information about the plant stand architecture which may be useful for instant crop identification from off-nadir satellite measurements. DOE

N87-18917# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.

NUMERICAL MODELS FOR THE EVALUATION OF GEOTHERMAL SYSTEMS

G. S. Bodvarsson, K. Pruess, and M. J. Lippmann Aug. 1986 28 p Presented at the International Meeting on Geothermics and Geothermal Energy, Guaruja, Brazil, 10 Aug. 1986

(Contract DE-AC03-76SF-00098)

(DE87-000128; LBL-22047; CONF-8608124-1) Avail: NTIS HC A03/MF A01

We have carried out detailed simulations of various fields in the USA (Bada, New Mexico; Heber, California); Mexico (Cerro Prieto); Iceland (Krafla); and Kenya (Olkaria). These simulation studies have illustrated the usefulness of numerical models for the overall evaluation of geothermal systems. The methodology for modeling the behavior of geothermal systems, different approaches to geothermal reservoir modeling and how they can be applied in comprehensive evaluation work are discussed. DOE

N87-18918# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

IMAGE DATA REDUCTION WITH SPLINES AND SEGMENTATION WITH EMPHASIS ON EARTH OBSERVATION

P. J. dePagter and J. J. Renes 11 Jan. 1985 192 p

(Contract NIVR-1874)

(NLR-TR-85139-U; B8677584; ETN-87-99502) Avail: NTIS HC A09/MF A01

The feasibility of image data compression using spline approximation and image segmentation, for Earth observation applications, was studied. The data compression method, implementation aspects, the test software, and test results are covered. It appears that a reduction factor of 5 to 10 is possible without significant visual loss of information. The spline approximation involves a convolution process. A simple hardware implementation is described. Benchmark tests yield an accuracy of 5 bits. Possible improvements are discussed. ESA

N87-18919# National Aerospace Lab., Amsterdam (Netherlands). Space Div.

THE PROCESSING OF AND INFORMATION EXTRACTION FROM AIRBORNE SLAR DATA

P. Binnenkade 24 Dec. 1985 23 p Presented at a Canada Center for Remote Sensing Seminar, Ottawa, Canada, 10 Oct. 1985

(NLR-MP-86004-U; B8679799; ETN-87-99511) Avail: NTIS HC A02/MF A01

Side-looking airborne radar crop identification in The Netherlands is discussed. Only a selected number of crops may be unambiguously identified, and crop growth stages must be closely monitored in order to select optimal flight dates and acquisition geometry. In order to proceed to operational conditions it is necessary to include internal and external calibration of the radar to allow for cross-comparison of data. Although external targets (corner reflectors) were placed at a number of locations throughout the test areas, consequences on processing and classification need further evaluation. It is argued that airborne programs will become largely obsolete due to the multitemporal and synoptic characteristics of spaceborne systems. ESA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N87-18920 British Library Lending Div., Boston Spa (England).

SURFACE OF CONTACT OF OXIDE PHASES IN HIGH-

TEMPERATURE GALVANIC CELLS WITH OXYGEN ELECTRODES
A. I. Sotnikov [1987] 10 p Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedenii, Chernaya Metallurgiya (USSR), no. 8, 1986 p 1-5
(BLL-M-37094-(5828.4)) Avail: British Library Lending Div., Boston Spa, Engl.

An examination is made of a high-temperature galvanic cell in which electrodes of the same inert metal are in contact with oxide melts of different compositions. The influence of sudden changes in potential at interfaces of the oxide phases and processes of reciprocal solution of phases on the emf of oxygen galvanic cells is analyzed. An equation is derived for calculating the emf of cells with one or several surfaces of contact of the oxide phases. Experimental conditions with which obtained emf data can be used more simply to determine the properties of metallic and oxide melts are examined. Author

N87-18921*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SCALLOPED-GEOMETRY SOLAR CONCENTRATOR Patent Application
Howard Andrew Wagner, inventor (to NASA) Filed 29 Oct. 1986 27 p
(NASA-Case-MSC-21061-1; NAS 1.71:MSC-21061-1; US-Patent-Appl-SN-924400) Avail: NTIS HC A03/MF A01 CSCL 10A

An improved solar collector is provided for concentrating solar energy at a target aperture of a receiver. The dispersion of reflected rays to the target aperture is substantially minimized over prior art arrangements. The collector is well suited as a component of a solar dynamic power unit for terrestrial use as well as space vehicles, concentrating sunlight to drive a heat engine. The solar concentrator includes a generally paraboloidal shape which is composed of sections or gores of compound curvature, the two inner edges of each gore (which abut the corresponding edges of adjacent gores) are parabolas. The compound curvature between the two edges of each gore being defined, in cross section, by a circular arc having its center at the focal point of the paraboloid. Novelty is believed to reside in the compound geometry which combines the advantages of both parabolas and circular arcs to minimize the dispersion of reflected rays from the desired target aperture. Author

N87-18922*# AeroVironment, Inc., Monrovia, Calif.
DEVELOPMENT AND TESTING OF VORTEX GENERATORS FOR SMALL HORIZONTAL AXIS WIND TURBINES Final Report
G. W. Gyatt Jul. 1986 45 p
(Contracts DEN3-367; DE-AI01-76ET-20320)
(NASA-CR-179514; DOE/NASA/0367-1; NAS 1.26:179514; AV-FR-86/822) Avail: NTIS HC A03/MF A01 CSCL 10A

Vortex generators (VGs) for a small (32 ft diameter) horizontal axis wind turbine, the Carter Model 25, have been developed and tested. Arrays of VGs in a counterrotating arrangement were tested on the inbound half-span, outboard half-span, and on the entire blade. VG pairs had their centerlines spaced at a distance of 15% of blade chord, with a spanwise width of 10% of blade chord. Each VG had a length/height ratio of 4, with a height of between 0.5% and 1.0% of the blade chord. Tests were made with roughness strips to determine whether VGs alleviated the sensitivity of some turbines to an accumulation of bugs and dirt on the leading edge. Field test data showed that VGs increased power output up to 20% at wind speeds above 10 m/s with only a small (less than 4%) performance penalty at lower speeds. The VGs on the outboard span of the blade were more effective than those on inner sections. For the case of full span coverage, the energy yearly output increased almost 6% at a site with a mean wind speed of 16 mph. The VGs did reduce the performance loss caused by leading edge roughness. An increase in blade pitch angle has an effect on the power curve similar to the addition of VGs. VGs alleviate the sensitivity of wind turbine rotors to leading edge roughness caused by bugs and drift. Author

N87-18923# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
TYPICAL PHOTOVOLTAIC SYSTEMS APPLICATIONS
Jul. 1986 33 p
(Contract DE-AC02-83CH-10093)
(DE86-010715; SERI/SP-273-2428) Avail: NTIS HC A03/MF A01

This publication provides a sampling of the photovoltaic applications developed under the auspices of the DOE, as well as a few of those supported by private companies and individuals. The applications span and a broad range of situations, locations, and purposes, demonstrating the flexibility of photovoltaics as an energy source. DOE

N87-18924# Delaware Univ., Newark. Inst. of Energy Conversion.
FUNDAMENTAL ENGINEERING ANALYSIS OF CdTe/CdS PHOTOVOLTAIC PROCESSING Final Subcontract Report, 1 Dec. 1983 - 31 May 1985
B. N. Baron, S. C. Jackson, and T. W. F. Russell Jun. 1986 181 p
(Contract DE-AC02-83CH-10093)
(DE86-010730; SERI/STR-211-2970) Avail: NTIS HC A09/MF A01

An engineering analysis of the deposition of CdTe and CdS thin-films by vacuum evaporation for fabricating photovoltaic solar cells has been carried out. Mathematical models describing the mass flows, molecular beam distributions, and film growth kinetics of CdTe and HgCdTe deposition have been developed and verified in laboratoy-scale experiments. Small-area CdTe/CdS photovoltaic devices having efficiencies of 6% were fabricated. Verified mathematical models were used to design large-scale evaporation sources. Commercially available architectural glass coating equipment can be adapted for large-area deposition of CdTe/CdS thin films in an in-line process for economically fabricatig thin-film CdTe/CdS photovoltaic modules. DOE

N87-18925# National Bureau of Standards, Gaithersburg, Md. Center for Building Technology.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF SOLAR RADIANT FLUX DISTRIBUTION ON INTERIOR SURFACES OF A SUNSPACE
S. T. Liu Mar. 1986 26 p Sponsored by DOE
(PB86-244167; NBSIR-86-3378) Avail: NTIS HC A03/MF A01 CSCL 10A

The short wave solar radiant flux distribution inside a sun-space model with a large south opening was studied experimentally under clear sky conditions. Miniature photovoltaic pyranometer sensors responsive to short wave radiation were mounted at various locations on the interior surfaces of the enclosure. An NBS developed solar flux distribution program was tested against the experimental results and was found to give good agreement. The computer program can be used as a design tool for the evaluation of thermal storage location and solar physical properties of flow and walls in a passive solar structure. GRA

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N87-18926*# Washington Univ., Seattle. Quaternary Research Center.
EMISSION OF METHANE AND OTHER TRACE GASES FROM THE AMAZON VARZEA Final Report, 1 Jan. 1985 - 31 Dec. 1986
Jeffrey E. Richey and Allan H. Devol Dec. 1986 69 p
(Grant NAGw-711)
(NASA-CR-177042; NAS 1.26:177042) Avail: NTIS HC A04/MF A01 CSCL 13B

Researchers measured the distributions and fluxes of methane and other trace gases from the various Amazon floodplain environments. These were determined during both a large scale, quasi-synoptic survey along a 2000 km reach of the Amazon river and an intensive local study (by J. Melack, R. Harriss et al.) covering a six-week period. The environments studied included the major rivers, connecting channels (paranas), floating macrophyte beds, flooded forests, open lakes and recently wetted soils. The results are summarized. Measured rates of methane emission averaged about 300 mg m-2 d-1, but with considerable variance, and were comparable to or higher than previously reported emissions from similar temperature zone environments. In general, areas covered by floating macrophytes showed the highest emissions. Individual hotspots had among the highest rates ever observed, over 10 g m-2 d-1. The high methane emissions appear to result because about 50% of the organic matter fixed on the floodplain (either terrestrial or aquatic) that is oxidized in the water is decomposed anaerobically via methanogensis. Measured fluxes of methane to the atmosphere appear to be significantly correlated with surface water dissolved methane concentrations. Author

N87-18927# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

PRELIMINARY CHARACTERIZATION OF THE SOUTHEASTERN BRAZILIAN ENVIRONMENT

L. M. Moreira-Nordemann, M. C. Forti, V. L. DiLascio, C. M. doEspirito Santo, O. M. Danelon, and J. C. Lopes Nov. 1986 109 p Submitted for publication

(INPE-4050-RPE/1014) Avail: NTIS HC A06/MF A01

Information about environmental conditions of the southeastern region of Brazil is given. Mainly, emission and also deposition of sulphur and nitrogen compounds are discussed, and directly related to pollution focus, corresponding to larger industrialized and urbanized areas of this region. The set of data presented was obtained in State Organs, charged to controlling the pollution, and also based in scientific works published by several authors. These data are recent, incomplete, and in many cases only refer to more industrialized and urbanized areas. Nevertheless, they constitute all the available data and all the information that was collected so far. This work does not present a complete diagnosis of the environmental conditions of the region, but is draws up the knowledge gained by actual experience in this area. Author

N87-18928# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

RATIOS OF EDDY TRANSFER COEFFICIENTS OVER THE AMAZON FOREST

Y. Viswanadham, Leonardo D. deAbreu Sa, Vicente deP. Silvao Filho, and Antonio O. Manzi Nov. 1986 15 p Proposed for presentation at the IAHS Assembly at IUGG, Vancouver, Canada, 9-22 Aug. 1987

(INPE-4059-PRE/1018) Avail: NTIS HC A02/MF A01

Simultaneous profile and eddy flux data gathered over the Amazon forest, Brazil, have been analyzed to find values of the nondimensional functions phi sub M,H,W and vertical eddy diffusivities K sub M, H, W (the subscripts M,H and W represent the parameters for momentum, heat and water vapor transfer, respectively). The ratios K sub H/K sub M and K sub H/K sub W are obtained from phi functions. The phi functions and ratios of eddy diffusivities are presented over a stability (Ri-Richardson number) range of -1.0 less than Ri less than 0.25. The results show: (1) in quasi-neutral conditions (-0.03 less than Ri less than 0.03), the inferred values of phi sub M, phi sub H and phi sub W are 1.28 + or - 0.13, 0.53 + or - 0.25 and 0.45 + or -0.15, respectively; (2) the ratios K sub H/K sub M, K sub W/K sub M and K sub H/K sub W are greater than unity in unstable, near neutral and slightly stable conditions; and (3) K sub H/K sub W is less than unity for Ri greater than 0.04. To account for the anomalies in K's, a brief discussion is presented based on turbulent transport processes. Author

N87-18929# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

IONIC COMPOSITION OF RAIN OF THE CITY OF SAO PAULO [COMPOSICAO IONICA DAS CHUVAS DA CIDADE DE SAO PAULO]

L. M. Moreira-Nordemann, M. C. Forti, F. deAndrade, and C. M. Q. Orsini Dec. 1986 9 p In PORTUGUESE; ENGLISH summary Presented at the 6th Symposium of Hydrology and Water Resources, Sao Paulo, Brazil, Nov. 1985 Submitted for publication (INPE-4064-PRE/1022) Avail: NTIS HC A02/MF A01

Nowadays scientific results show many important variations in the chemical composition of the atmosphere as results of human interferences. On the other hand, the rain becomes acid in several regions of the planet and the ion concentrations of rain water seem to increase. In this work we studied the chemical composition of rain water in Sao Paulo City. pH and Na+, Ca2+, K+, Mg2+, Cl-, SO 2-, NO3 and NH+4 concentrations were determined in 63 rain water samples. Data obtained are analyzed related to natural and anthropogenic conditions of this locality. Results are also compared with some data about chemical composition of surface waters of the region. Author

N87-18930# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

GEOCHEMISTRY AND THE ENVIRONMENT [GEOQUIMICO E O MEIO-AMBIENTE]

L. M. Moreira-Nordemann Dec. 1986 47 p In PORTUGUESE; ENGLISH summary Submitted for publication

(INPE-4066-PRE/1004) Avail: NTIS HC A03/MF A01

Geochemistry in Brazil is investigated and many scientific papers were presented on several subjects related to soils, water, rocks, and atmosphere. Studies about environmental conditions in this country, were just started. An overview on geochemistry and environmental problems is presented, focussing on atmospheric chemistry, hydrogeochemistry, and soil pollution. Author

N87-18931# Rhode Island Univ., Kingston. Graduate School for Oceanography.

ARCTIC HAZE: NATURAL OR POLLUTION? Progress Report

Kenneth A. Rahn and Douglas H. Lowenthal 1 Nov. 1986 159 p

(AD-A174025) Avail: NTIS HC A08/MF A01 CSCL 04/2

A 3-year program of continued research on Arctic haze is planned. The research builds on the accomplishments of the past three years and extends them, with particular emphasis on strengthening the new elemental tracer system, attempting to determine the history of Arctic haze by analyzing the Russian/Norwegian ice core from Nordauslandet, and analyzing aircraft samples from the AGASP II aircraft experiment of spring 1986. The tracer system will be improved in at least three ways: its statistical aspects will be refined, innovative ways of deriving signatures from hard-to-sample areas will be explored, and the tracer power of several noble metals will be determined. From the Nordauslandet core, as many as 100 to 200 samples will be analyzed for trace elements with our new technique developed under DOE sponsorship: we hope to use the results to write both the modern history of Arctic haze and the history of the various regions contributing to it. An extensive set of aircraft samples from AGASP II will be analyzed for trace elements and compared with the results of other investigators. GRA

N87-18932# Air Force Systems Command, Patrick AFB, Fla. Space and Missile Center.

OPERATIONAL USE OF AIR POLLUTION MODELS AT THE SPACE AND MISSILE RANGES Final Report

Billie F. Boyd and Clinton R. Bowman, Jr. 15 Nov. 1986 11 p (AD-A174285; ESMC-TR-86-01) Avail: NTIS HC A02/MF A01 CSCL 15/7

The Space Shuttle exhaust ground and cloud results from the exhaust plume from the Space Shuttle Main Engines and the Solid Rocket Boosters initially impinging on the launch complex and flame trench. The initial ground cloud is formed from high-temperature combustion products and vaporized flame trench

water. The exhaust cloud rises to an altitude at which buoyant equilibrium with the ambient atmosphere is established, i.e., 1 to 2 km in a period of 5 to 10 min after launch. At this point, the kinematic transport phase commences. At stabilization, the exhaust cloud typically contains approximately 99 percent ambient air entrained during the cloud rise portion of its transport. The major rocket exhaust constituents are hydrogen chloride (HCl), carbon dioxide (CO2), water vapor (H2O), and aluminum oxide (Al2O3). The REEDM (Rocket Exhaust Effluent Diffusion Model) computer code is currently used to provide a real-time dispersion prediction during each launch of the Space Shuttle. It has also been used to assess the environmental impact for future Shuttle launches at the Western Test Range. The REEDM includes basic mathematical expressions for atmospheric dispersion models, cloud-rise models for calculating the gravitational deposition of acid drops. Inputs are vehicle and other source parameters; meteorological parameters defining the state of the planetary boundary layer including turbulence parameters, and physical properties of the rocket exhaust cloud. GRA

N87-18933# Oak Ridge National Lab., Tenn. Div. of Environmental Sciences.
ATMOSPHERIC CARBON DIOXIDE CHANGE: AGENT OF FUTURE FOREST GROWTH OR DECLINE
A. M. Solomon and D. C. West 1986 28 p Presented at the International Conference on Health and Environmental Effects of Ozone Modification and Climate Change, Arlington, Va., 16 Jun. 1986
(Contract DE-AC05-84OR-21400)
(DE86-015651; CONF-8606210-1) Avail: NTIS HC A03/MF A01

Greenhouse experiments showed that enhanced CO2 positively affects woody seedling growth and that these effects may also occur in saplings and mature trees under elevated CO2 concentrations. The potential response of forests was examined using a computer model of tree growth and forest stand development with simultaneous changes in CO2 and climate, as well as the known responses of trees to these variables. The results of these simulation experiments imply that the initial forest responses to changes in the environmental variables associated with increasing CO2 may be minor because of tree longevity. In the long term, however, negative effects of climate change on forest growth may be strong enough to overwhelm the positive benefits derived from enhanced CO2. Direct CO2 benefits could, nevertheless, change the magnitude and the time required by forests to respond to climate change. DOE

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N87-18934*# Lamont-Doherty Geological Observatory, Palisades, N.Y.
INTER- AND INTRA-PLATE DEFORMATION AT NORTH AMERICAN PLATE BOUNDARIES Semiannual Status, 1 Jul. - 31 Dec. 1986
John Beavan Dec. 1986 8 p
(Grant NAG5-799)
(NASA-CR-180157; NAS 1.26:180157) Avail: NTIS HC A02/MF A01 CSCL 08E

Alaska tectonics and earthquake hazard studies; Southern California tectonics (block rotation); spreading near the Salton Trough; California plate motion (fault zone kinematics); and Caribbean plate motion investigations are examined. B.G.

N87-18935*# ST Systems Corp., Hampton, Va.
SAM 2 AND SAGE DATA MANAGEMENT AND PROCESSING
M. T. Osborn and C. R. Trepte Feb. 1987 62 p
(Contract NAS1-17165)
(NASA-CR-178244; NAS 1.26:178244) Avail: NTIS HC A04/MF A01 CSCL 04A

The data management and processing supplied by ST Systems Corporation (STX) for the Stratospheric Aerosol Measurement 2 (SAM 2) and Stratospheric Aerosol and Gas Experiment (SAGE) experiments for the years 1983 to 1986 are described. Included are discussions of data validation, documentation, and scientific analysis, as well as the archival schedule met by the operational reduction of SAM 2 and SAGE data. Work under this contract resulted in the archiving of the first seven years of SAM 2 data and all three years of SAGE data. A list of publications and presentations supported was also included. Author

N87-18936*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NASA LANGLEY RESEARCH CENTER TETHERED BALLOON SYSTEMS
Thomas L. Owens, Richard W. Storey, and Otto Youngbluth Feb. 1987 34 p
(NASA-TM-83260; NAS 1.15:83260) Avail: NTIS HC A03/MF A01 CSCL 04A

The NASA Langley Research Center tethered balloon system operations are covered in this report for the period of 1979 through 1983. Meteorological data, ozone concentrations, and other data were obtained from in situ measurements. The large tethered balloon had a lifting capability of 30 kilograms to 2500 meters. The report includes descriptions of the various components of the balloon systems such as the balloons, the sensors, the electronics, and the hardware. Several photographs of the system are included as well as a list of projects including the types of data gathered. Author

N87-18937*# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
SPHERICAL HARMONIC EXPANSIONS OF THE EARTH'S GRAVITATIONAL POTENTIAL TO DEGREE 360 USING 30' MEAN ANOMALIES
Richard H. Rapp and Jaime Y. Cruz Dec. 1986 25 p
(Grant NGR36-008-161)
(NASA-CR-180251; NAS 1.26:180251; DGSS-Rept-376) Avail: NTIS HC A02/MF A01 CSCL 08G

Two potential coefficient fields that are complete to degree and order 360 have been computed. One field (OSU86E) excludes geophysically predicted anomalies while the other (OSU-86F) includes such anomalies. These fields were computed using a set of 30' mean gravity anomalies derived from satellite altimetry in the ocean areas and from land measurements in North America, Europe, Australia, Japan and a few other areas. Where no 30' data existed, 1 deg x 1 deg mean anomaly estimates were used if available. No rigorous combination of satellite and terrestrial data was carried out. Instead advantage was taken of the adjusted anomalies and potential coefficients from a rigorous combination of the GEML2' potential coefficient set and 1 deg x 1 deg mean gravity anomalies. The two new fields were computed using a quadrature procedure with de-smoothing factors. The spectra of the new fields agree well with the spectra of the fields with 1 deg x 1 deg data out to degree 180. Above degree 180 the new fields have more power. The fields have been tested through comparison of Doppler station geoid undulations with undulations from various geopotential models. The agreement between the two types of undulations is approximately + or - 1.6 m. The use of a 360 field over a 180 field does not significantly improve the comparison. Instead it allows the comparison to be done at some stations where high frequency effects are important. In addition maps made in areas of high frequency information (such as trench areas) clearly reveal the signal in the new fields from degree 181 to 360. Author

N87-18938# National Oceanic and Atmospheric Administration, Washington, D. C.
THE COMPLEMENTARY ROLES OF MICROWAVE AND INFRARED INSTRUMENTS IN ATMOSPHERIC SOUNDING
Feb. 1987 33 p

(NOAA-TR-NESDIS-29) Avail: NTIS HC A03/MF A01

Radiance measurements in the infrared and microwave regions respond differently to changes in the atmosphere. These differences in response lead to differences in the ability to derive profiles of atmospheric parameters such as temperature and moisture. A summary of the characteristics of each region is presented, followed by an evaluation of the results of simulation studies and extrapolations from existing instruments, both of which were designed to assess the relative advantages of the two wavelength regions. The studies show that the combination of the information from the two spectral regions leads to more accurate retrievals than can be obtained from either spectral region alone at all levels of the atmosphere. For levels where the microwave retrievals were clearly more accurate than the infrared, the combination of information from the two regions increased the accuracy by a minimum of 0.1 K. For other levels, the increase in accuracy is larger. The infrared information is particularly helpful in increasing the accuracy of microwave soundings in the lower atmosphere below the 700 mb surface. In this region, the combination increased the accuracy by 0.5 to 1.0 K, depending on the region and the particular study. This represents a reduction in error of about 25% of the error produced by microwave measurements alone. Author

N87-18939# Atmospheric and Environmental Research, Inc., Cambridge, Mass.

MULTIPLE SCATTERING TREATMENT FOR USE IN THE LOWTRAN AND FASCODE MODELS Final Report, 1 Jan. 1984 - 31 Mar. 1986

7 Apr. 1986 234 p

(Contract F19628-84-C-0028)

(AD-A173990; P95F; AFGL-TR-86-0073) Avail: NTIS HC A11/MF A01 CSCL 04/1

An evaluation of available approaches to treat the coupled processes of multiple-scattering due to atmospheric molecules and aerosols, and nongray absorption due to atmospheric gases is performed. Based on the evaluation and consideration of the requirements of efficiency, accuracy and code structure of LOWTRAN and FASCODE models, we recommend that an approach based on the stream approximation together with the k-distribution method is best suited for implementation into these models. The parameterization is unique in the sense that the k-distribution method decouples the multiple-scattering from the treatment of non-gray gaseous absorption so that the stream approximation can be used to treat multiple scattering in both the LOWTRAN and FASCODE models. The stream approximation is extremely attractive since it retains the analytical simplicity (and hence, efficiency) of single scattering while improving the treatment of multiple-scattering (and hence, accuracy). GRA

N87-18940# National Oceanic and Atmospheric Administration, Boulder, Colo. Air Resources Lab.

SIMULATION OF CLOUDS, PRECIPITATION, AND AIRFLOW OVER COMPLEX TERRAIN USING A THREE-DIMENSIONAL MESOSCALE MODEL Final Report, 6 Jan. - 31 Oct. 1986

E. C. Nickerson 31 Oct. 1986 118 p

(Contract W-7405-eng-36)

(DE87-000564; DOE/NBM-7000564) Avail: NTIS HC A06/MF A01

The results of an evaluation of the numerical dispersion associated with the horizontal differencing scheme are discussed. Results of precipitation, clouds, and airflow over a region of complex terrain 200 km by 200 km located in the southwest of Colorado using terrain supplied by the technical representatives from LANL are presented. DOE

N87-18941# Stockholm Univ. (Sweden). Dept. of Meteorology.

AURORAL ZONE NITROGEN OXIDE ABUNDANCIES FROM ROCKET-BORNE CONTINUUM MEASUREMENTS

Joanna Rose 10 Jun. 1986 98 p

(Contracts DR-572; DR2179)

(AP-27; ISSN-0280-4441; ETN-87-99115) Avail: NTIS HC A05/MF A01

A nitric oxide altitude profile was derived from a photometric measurement of the intensity of green nightglow continuum. The emission is known to arise from the chemiluminescent recombination of nitric oxide and atomic oxygen. The observed enhancement in the continuum emission is consistent with previous measurements. The derived concentration of nitric oxide is in agreement with concentrations obtained by different techniques under similar conditions. It shows an expected enhancement of the peak concentration (1.2 billion ph/A/sec/cc at 99 km) associated with enhanced photochemical production as well as transport processes of nitric oxide in auroral zone during polar night. ESA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N87-18942*# Computer Sciences Corp., Huntsville, Ala.

STUDY OF WIND CHANGE FOR THE DEVELOPMENT OF LOADS REDUCTION TECHNIQUES FOR THE SPACE SHUTTLE

S. I. Adelfang Washington NASA Feb. 1987 214 p

(Contract NAS8-35974)

(NASA-CR-4045; NAS 1.26:4045) Avail: NTIS HC A10/MF A01 CSCL 04B

Wind change statistics are analyzed for Vandenberg AFB, California (VAFB) and Kennedy Space Center, Florida (KSC). Means and standard deviations of wind component change and vector wind change modulus within 3-9 and 9-16 km altitude bands are tabulated. The contribution to 3.5 hr wind component change by wind perturbations in various wavelength bands is evaluated. Probability distributions of maximum 3.5 hr wind change in an altitude band are presented and a model for wind change at a specified altitude is tested with data derived from six data bases from VAFB and Santa Monica, California. Author

N87-18943# Mississippi Univ., University. Physical Acoustics Research Group.

ELECTRICAL ACTIVITY AS OBSERVED FROM BENEATH SUPERCELL THUNDERSTORMS Final Report

Roy T. Arnold [1987] 41 p

(Contract NA79RAD00007)

Avail: NTIS HC A03/MF A01

Observations made while tracking severe convective storms make it possible to interpret visual cloud features in terms of storm structure. Use of cloud features to infer either dynamics or correlations between electrical and dynamical properties is qualitative. But there is little doubt that cloud features indicative of storm development can be identified. The data for the 19 June 1980 isolated supercell indicate that the main updraft is very important in both the electrification of the storm and in its electrical history. Each time there was any evidence that the updraft might have weakened, then a preceding decrease in the cloud to ground lightning strike rate preceded the weakening. Our impression is that the magnitude of the flash-to-ground rate during a storm's mature stage is probably determined by the mechanism by which the updraft is throttled, but probably not the temporal variation. Speculations about possible correlations between storm electricity and dynamics provide some insight into the direction of continued study of severe storms, but in the absence of results from specific experiments designed to test particular aspects of co-evolving dynamics and electricity, the electrical character of these enormously large thunderstorms will remain within the realm of speculation. Author

N87-18944*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A SURVEY OF NESTED GRID TECHNIQUES AND THEIR POTENTIAL FOR USE WITHIN THE MASS WEATHER PREDICTION MODEL

Steven E. Koch and Jeffery T. McQueen (ST Systems Corp., Hyattsville, Md.) Feb. 1987 28 p

(Contract NAS5-28752)

(NASA-TM-87808; Rept-87B0116; NAS 1.15:87808) Avail: NTIS HC A03/MF A01 CSCL 04B

A survey of various one- and two-way interactive nested grid techniques used in hydrostatic numerical weather prediction models is presented and the advantages and disadvantages of each method are discussed. The techniques for specifying the lateral boundary conditions for each nested grid scheme are described in detail. Averaging and interpolation techniques used when applying the coarse mesh grid (CMG) and fine mesh grid (FMG) interface conditions during two-way nesting are discussed separately. The survey shows that errors are commonly generated at the boundary between the CMG and FMG due to boundary formulation or specification discrepancies. Methods used to control this noise include application of smoothers, enhanced diffusion, or damping-type time integration schemes to model variables. The results from this survey provide the information needed to decide which one-way and two-way nested grid schemes merit future testing with the Mesoscale Atmospheric Simulation System (MASS) model. An analytically specified baroclinic wave will be used to conduct systematic tests of the chosen schemes since this will allow for objective determination of the interfacial noise in the kind of meteorological setting for which MASS is designed. Sample diagnostic plots from initial tests using the analytic wave are presented to illustrate how the model-generated noise is ascertained. These plots will be used to compare the accuracy of the various nesting schemes when incorporated into the MASS model. Author

N87-18945# Federal Aviation Administration, Atlantic City, N.J.
THE OPERTIONAL SUITABILITY OF THE AUTOMATED WEATHER OBSERVING SYSTEM (AWOS) AT HELIPORTS Final Report, Oct. 1986
Rene A. Matos and Rosanne M. Weiss Feb. 1987 29 p
(DOT/FAA/PM-86/52; DOT/FAA/CT-87/3) Avail: NTIS HC A03/MF A01

A questionnaire, based on an OPM-approved questionnaire, was distributed to pilots and users who were involved in the project, The Siting, Installation, and Operational Suitability of the Automated Weather Observing System (AWOS) at Heliports. This report documents the conclusions of the questionnaire analysis and provides basis for the determination of operational suitability of AWOS at heliports. Author

N87-18946*# Texas A&M Univ., College Station.
PRECIPITATION FACTORS LEADING TO ARC CLOUD FORMATION Final Report, Oct. 1985 - Apr. 1987
Kenneth C. Brundidge Apr. 1987 227 p
(Grant NAG8-043)
(NASA-CR-180244; NAS 1.26:180244) Avail: NTIS HC A11/MF A01 CSCL 04B

The combined efforts of three graduate students and the principal investigator are presented. Satellite observations and interpretation have become increasingly important in the areas of weather research and operational forecasting. One reason is that geostationary satellite imagery is the only meteorological observing tool that can follow the evolution of clouds from the synoptic scale down to the cumulas scale. Therefore, it can depict atmospheric activity which is up to two orders of magnitude smaller than can be resolved by conventional meteorological observations. This unique ability of the satellite provides the meteorologist a mechanism to infer weather events down to the mesoscale. This evolution is the subject of this report. For individual titles, see N87-18947 through N87-18949.

N87-18947*# Texas A&M Univ., College Station.
FACTORS LEADING TO THE FORMATION OF ARC CLOUD COMPLEXES
Mark John Welshinger and Kenneth C. Brundidge *In its* Precipitation Factors Leading to Arc Cloud Formation Apr. 1987 116 p (For primary document see N87-18946 11-47)
Avail: NTIS HC A11/MF A01 CSCL 04B

A total of 12 mesoscale convective systems (MCSs) were investigated. The duration of the gust front, produced by each MCS, was used to classify the MCSs. Category 1 MCSs were defined as ones that produced a gust front and the gust front lasted for more than 6 h. There were 7 category 1 MCSs in the sample. Category 2 MCSs were defined as ones that produced a gust front and the gust front lasted for 6 h or less. There were 4 category 2 MCSs. The MCS of Case 12 was not categorized because the precipitation characteristics were similar to a squall line, rather than an MCS. All of the category 1 MCSs produced arc cloud complexes (ACCs), while only one of the category 2 MCSs produced an ACC. To determine if there were any differences in the characteristics between the MCSs of the two categories, composite analyses were accomplished. The analyses showed that there were significant differences in the characteristics of category 1 and 2 MCSs. Category 1 MCSs, on average, had higher thunderstorm heights, greater precipitation intensities, colder cloud top temperatures and produced larger magnitudes of surface divergence than category 2 MCSs. Author

N87-18948*# Texas A&M Univ., College Station.
CONVECTIVE CELL DEVELOPMENT AND PROPAGATION IN A MESOSCALE CONVECTIVE COMPLEX
Yoo-Shin Ahn and Kenneth C. Brundidge *In its* Precipitation Factors Leading to Arc Cloud Formation Apr. 1987 63 p (For primary document see N87-18946 11-47)
Avail: NTIS HC A11/MF A01 CSCL 04B

A case study was made of the mesoscale convective complex (MCC) which occurred over southern Oklahoma and northern Texas on 27 May 1981. This storm moved in an eastsoutheasterly direction and during much of its lifetime was observable by radars at Oklahoma City, Ok. and Stephenville, Tx. It was found that the direction of cell (VIP level 3 or more reflectivity) propagation was somewhat erratic but approximately the same as the system (VIP level 1 reflectivity) movement and the ambient wind. New cells developed along and behind the gust front make it appear that once the MCC is initiated, a synergistic relationship exists between the gust front and the MCC. The relationship between rainfall patterns and amounts and the infrared (IR) temperature field in the satellite imagery were examined. The 210 K isotherm of GOES IR imagery was found to encompass the rain area of the storm. The heaviest rainfall was in the vicinity of the VIP level 3 cells and mostly contained within the 205 K isotherm of GOES IR imagery. Author

N87-18949*# Texas A&M Univ., College Station.
NIGHTTIME ATMOSPHERIC STABILITY CHANGES AND THEIR EFFECTS ON THE TEMPORAL INTENSITY OF A MESOSCALE CONVECTIVE COMPLEX
Jeffrey S. Hovis and Kenneth C. Brundidge *In its* Precipitation Factors Leading to Arc Cloud Formation Apr. 1987 46 p (For primary document see N87-18946 11-47)
Avail: NTIS HC A11/MF A01 CSCL 04B

A method of interpolating atmospheric soundings while reducing the errors associated with simple time interpolation was developed. The purpose of this was to provide a means to determine atmospheric stability at times between standard soundings and to relate changes in stability to intensity changes in an MCC. Four MCC cases were chosen for study with this method with four stability indices being included. The discussion centers on three aspects for each stability parameter examined: the stability field in the vicinity of the storm and its changes in structure and magnitude during the lifetime of the storm, the average stability within the storm boundary as a function of time and its relation to storm intensity, and the apparent flux of stability parameter into the storm as a consequence of low-level storm relative flow. It was found that the results differed among the four stability parameters, sometimes in a conflicting fashion. Thus, an interpolation of how the storm intensity is related to the changing environmental stability depends upon the particular index utilized. Some explanation for this problem is offered. Author

N87-18950*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ATMOSPHERIC ENVIRONMENT FOR SPACE SHUTTLE

(STS-51L) LAUNCH
G. L. Jasper, D. L. Johnson, M. Alexander, G. H. Fichtl, and G. W. Batts (Computer Sciences Corp., Huntsville, Ala.) Dec. 1986 124 p
(NASA-TM-86577; NAS 1.15:86577) Avail: NTIS HC A06/MF A01 CSCL 04B

A summary is given of selected atmospheric conditions observed near Space Shuttle STS-51L launch time on January 28, 1986, at Kennedy Space Center, Florida. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of pre-launch Jimsphere measured vertical wind profiles is given. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-51L vehicle ascent has been constructed. The STS-51L ascent atmospheric data tape has been constructed by Marshall Space Flight Center's Atmospheric Sciences Division to provide an internally consistent data set for use in post flight performance assessments. Author

N87-18951# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DEACON NUMBER FOR WIND AND TEMPERATURE ABOVE THE AMAZON FOREST [NUMERO DE DEACON PARA PERFIS DE VENTO E TEMPERATURA ACIMA DA FLORESTA AMAZONICA]
Vicente Silva Filho and Yelisetty Viswanadham Dec. 1986 20 p In PORTUGUESE; ENGLISH summary
(INPE-4097-RPE/532) Avail: NTIS HC A02/MF A01

Effects caused by a steady state of boundary heating (or cooling) on the structure of the mean wind, temperature and humidity profiles are important in the lower atmosphere. In comparison to adiabatic surface layer conditions, boundary heating of this layer is known to produce two interrelated effects: (1) change in profile curvature and (2) change of average profile steepness (wind gradient or shear). The mathematically simplest form which illustrates the two effects is the power law of Deacon (1949). The Deacon number is a convenient parameter for expressing the vertical curvature of the profiles in the atmospheric boundary layer. The data sets used to obtain the Deacon numbers for the wind and temperature profiles (B) are extracted from the Amazon micrometeorological experiment. The parameters Bu for wind and Bo for temperature are evaluated for different stability conditions of the atmosphere. With the help of these parameters and the Richardson number, various physical aspects of the lower atmospheric boundary layer above the forest canopy are presented. The observed range of values of Bu is roughly 1.88 to 0.22 and of Bo is 1.77 to 0.02 for the selected data sets. Author

N87-18952# Air Force Armament Lab., Eglin AFB, Fla.
CLIMATOLOGY OF SURFACE WINDS: HOLLOMAN HIGH SPEED TEST TRACK Final Report, 1 Sep. 1980 - 31 Aug. 1986
Richard F. Himebrook 25 Sep. 1986 74 p
(AD-A174937; AD-TR-86-33) Avail: NTIS HC A04/MF A01 CSCL 04/2

A summary is given of wind climatology at the Holloman High Speed Test Track from 1 September 1980 to 31 August 1986. This report includes background on collection methods, interpretation procedures, quality control of data, several summaries of data, and FORTRAN programs for quality control and data processing. GRA

N87-18953# Oregon State Univ., Corvallis.
MODEL PROJECTIONS OF THE EQUILIBRIUM CLIMATIC RESPONSE TO INCREASED CARBON DIOXIDE
M. E. Schlesinger and J. F. B. Mitchell 1986 67 p Prepared in cooperation with Meteorological Office, Bracknell, England
(Contract W-7405-eng-48)
(DE86-010555; UCRL-15807) Avail: NTIS HC A04/MF A01

To investigate the extent to which a doubling of the CO2 concentration would alter the Earth's climate, a hierarchy of mathematical climate models was used to simulate the change in the equilibrium climate resulting from a doubling of the CO2 concentration from 300 to 600 ppM. The results from simulations by energy balance models, radiative-convective models, and atmospheric general circulation models are critiqued in this report. DOE

N87-18954# Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.
SURGING AS A POTENTIAL RESPONSE OF ICE SHEETS TO CO2-INDUCED CHANGES IN THE POLAR ENVIRONMENT Progress Report, Sep. 1985 - Aug. 1986
U. Radok and C. S. Lingle Aug. 1986 23 p
(Contract DE-AC02-84ER-60197)
(DE87-000415; DOE/ER-60197/9) Avail: NTIS HC A02/MF A01

The past year has brought the Project within sight of its twin objectives - an assessment of the current potential for Antarctic surges that would affect sea level, and the development of improved models for simulating the ice sheet behavior in response to CO- induced warming. Revised plans for the conclusion of the Project, during the remainder of 1986 and a five-month no-cost extension, have been made necessary by personnel changes and are desirable for the full exploitation of results. DOE

N87-18955# Massachusetts Univ., Amherst.
STUDIES OF CLIMATIC VARIABILITY DURING THE PERIOD OF INSTRUMENTAL RECORDS Annual Report
C. M. Goodess (East Anglia Univ., Norwich, England), R. S. Bradley, P. M. Kelly, P. D. Jones, and H. F. Diaz (National Oceanic and Atmospheric Administration, Boulder, Colo.) Nov. 1986 12 p Prepared in cooperation with East Anglia Univ. (UK). Climatic Research Unit; National Oceanic and Atmospheric Administration, Boulder, Colo.
(Contract DE-FG02-85ER-60316)
(DE87-003694; DOE/ER-60316/T1; AR-2) Avail: NTIS HC A02/MF A01

The aim was to analyze the Department of Energy long-term climatic data bank to investigate the carbon dioxide-climate question. In the second year of the study, the focus was on: (1) analysis of long-term precipitation for Northern Hemisphere land areas; (2) evaluation of the influence of various forcing factors on the temperature and precipitation record of the last 130 years; (3) analysis of the Comprehensive Ocean-Atmosphere Data Set (COADS) and merging with the DOE land data set; and (4) analysis of the effects of the El Nino/Southern Oscillation (ENSO) phenomenon on the temperature and precipitation variability of the Northern Hemisphere land areas. DOE

N87-18956# Amerind Publishing Co. Pvt. Ltd., New Delhi (India). Div. of Polar Programs.
PROBLEMS OF THE ARCTIC AND THE ANTARCTIC, COLLECTION OF ARTICLES, VOLUME 58, 1984
B. A. Krutskikh, ed. 1985 161 p Transl. into ENGLISH of the book "Problemy Arktiki i Antarktiki, Sbornik Statei, Vyp. 58" Leningrad, USSR, Gidrometeorologicheskoe, 1984 p 1-153
(PB86-246956; TT-85-00-101) Avail: NTIS HC A08/MF A01 CSCL 04B

Included are articles highlighting the results of investigations conducted by Soviet researchers in the Arctic and the Antarctic. These articles deal with a wide range of subjects, i.e., hydrology, atmospheric circulation, physical meteorology and sea ice studies. The two articles contributed by A.P. Bizyuk on the psychological state of personnel working in polar stations in the Arctic and Antarctic deserve special attention. GRA

N87-18957# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Lab.
MONITORING INSTRUMENTATION FOR THE CONTINUOUS MEASUREMENT AND QUALITY ASSURANCE OF METEOROLOGICAL OBSERVATIONS
G. A. Herbert, E. R. Green, G. L. Koenig, and K. W. Thaut Jul. 1986 51 p
(PB86-245966; NOAA-TM-ERL-ARL-148) Avail: NTIS HC A04/MF A01 CSCL 04B

The growth in concentration of trace constituents in the atmosphere due to anthropogenic activity is well documented.

The subsequent potential for them to cause climate change through redistribution of radiation is now under intense study. The Geophysical Monitoring for Climatic Change (GMCC) program was formed in 1971 to monitor atmospheric constitutents such as CO2, aerosols, and ozone. The report describes the development and testing of an Instrumentation Control and Monitoring System to meet the needs of the meteorological instrumentation at the GMCC observatories. GRA

N87-18958# National Bureau of Standards, Gaithersburg, Md. Building Physics Div.
FINAL EVALUATION OF A COLOR CALIBRATOR FOR A RADAR REMOTE WEATHER DISPLAY SYSTEM
L. G. Porter Jul. 1986 86 p Sponsored by FAA
(PB86-245735; NBSIR-86-3403) Avail: NTIS HC A05/MF A01 CSCL 04B

The report describes the development and field testing of an inexpensive color calibrator for the standardization of the Weather Intensity Level (WIL) colors used in the FAA's Radar Remote Weather Display System or RRWDS. The report covers the field validation of the color calibrator and, as an end product, the construction of a tentative look-up table that identifies whether the six WIL colors are within acceptable limits. In addition, the report includes a general review of significant literature on color-coding, since RRWDS color codes weather information. The report presents first-of-its-kind objective data on the effects of ambient room lighting on colors used in a self-luminous display. GRA

N87-18959# Pacific Northwest Labs., Richland, Wash.
TORNADO CLIMATOLOGY OF THE CONTIGUOUS UNITED STATES
J. V. Ramsdell and G. L. Andrews May 1986 290 p
(Grant NRC FIN-B-2960)
(TI86-005189; NUREG-CR-4461) Avail: NTIS HC A13/MF A01

The characteristics of tornadoes that were reported in the contiguous United States for the period from January 1, 1954, through December 31, 1983, have been computed from data in the National Severe Storms Forecast Center tornado data base. The characteristics summarized include frequency and locations of tornadoes, and their lengths, widths, and areas. Tornado strike and intensity probabilities have been estimated on a regional basis, and these estimates have been used to compute wind speeds with 0.00001, 0.000001, and 0.0000001 probabilities of occurrence. The 0.0000001 yr(-1) wind speeds range from below 200 mph in the western United States to about 330 mph in the vicinity of Kansas and Nebraska. The appendices contain extensive tabulations of tornado statistics. Variations of the characteristics within the contiguous United States are presented in the summaries. Separate tabulations are provided for the contiguous United States, for each state, for each 5 deg and 1 deg. latitude and longitude box, and for the eastern and western United States. Author

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N87-18960*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A METHOD OF CALCULATING THE TOTAL FLOW FROM A GIVEN SEA SURFACE TOPOGRAPHY
Desiraju B. Rao (National Meteorological Center, Washington, D.C.), Stephen D. Steenrod (Applied Research Corp., Landover, Md.), and Braulio V. Sanchez Apr. 1987 24 p
(NASA-TM-87799; Rept-87B0128; NAS 1.15:87799) Avail: NTIS HC A02/MF A01 CSCL 08C

Using a simple dynamical model of a wind-driven ocean circulation of the Stommel type, and an analytical basis developed to objectively analyze the sea surface height residuals from an altimeter and, in the process, to determine the total flow instead of just the near surface geostrophic component associated with the given sea surface topography. The method is based on first deriving the solution to the forced problem for a given wind stress required to develop a hypothetical true or perfect data field and to establishing the basis for the objective analysis. The stream function and the surface height field for the forced problem are developed in terms of certain characteristic functions with the same expansion coefficients for both fields. These characteristic functions are simply the solutions for a homogeneous elliptic equation for the stream function and the solutions of an inhomogeneous balance equation for the height field. For the objective analysis, using a sample of randomly selected height values from the true data field, the height field characteristic functions are used to fit the given topography in a least squares sense. The resulting expansion coefficients then permit the synthesis of the total flow field via the stream function characteristic modes and the solution is perfectly well behaved even along the equator. The method of solution is easily adaptable to realistic ocean basis by straight forward numerical methods. The analytical basis of the theory and the results for an ideal rectangular basin on a beta plane are described. Author

N87-18961# Office of Naval Research, Arlington, Va.
PHYSICAL OCEANOGRAPHY PROGRAM SCIENCE ABSTRACTS Annual Report, for Period Ending FY85
Thomas Spence 1 Apr. 1986 143 p
(AD-A174019) Avail: NTIS HC A07/MF A01 CSCL 08/3

This report presents a summary of work sponsored by the Physical Oceanography Program, ONR, Environmental Sciences Directorate, covering the FY85 period. It includes brief descriptions of research for about 110 physical oceanography projects, and a bibliography containing publications in FY85 supported by the program. GRA

N87-18962# Scripps Institution of Oceanography, La Jolla, Calif. Marine Physical Lab.
NONLINEAR DYNAMICS AND INTERNAL WAVES Final Report, 1 Jan. 1983 - 31 Mar. 1985
Henry D. Abarbanel 1985 6 p
(Contract N00014-83-K-0109; ARPA Order 4946)
(AD-A174293; MPL-U-56/85) Avail: NTIS HC A02/MF A01 CSCL 20/4

This research has concentrated on two topics: (1) the evaluation of transport equations and transport coefficients relating to systems with widely differing spatial and temporal scales. This was motivated by the desire to understand the transfer of momentum, energy, etc., from the mesoscale to the smaller oceanic scales and especially internal waves; and, (2) nonlinear stability of fluid and plasma flows using this method developed by Arnold. GRA

N87-18963# Naval Postgraduate School, Monterey, Calif.
THE RELATIONSHIP BETWEEN MARINE AEROSOL OPTICAL DEPTH AND SATELLITE-SENSED SEA SURFACE TEMPERATURE M.S. Thesis
Susan K. Runco Jun. 1986 77 p
(AD-A174337) Avail: NTIS HC A05/MF A01 CSCL 17/5

Multichannel sea surface temperatures (MCSST) computed from NOAA 7 AVHRR channels 4 and 5 are compared to sea surface temperatures measured by an aircraft radiometer (PRT-5). This data set was collected in Fall, 1982 off the southern Californian coast. The MCSST was warmer by 0.82 degrees in the area aerosol effects did not offset increasing radiance due to vertically warming air temperature. As aerosols were able to offset the temperature contribution to radiance, the difference between MCSST and PRT-5 SST measurements decreased. Aerosol effects on infrared radiance were qualitatively examined using an atmospheric transmittance model (LOWTRAN 6). Comparing the model and PRT-5 results indicates that below the marine boundary layer, high aerosol extinction caused significant cooling. Above the boundary layer, aerosols scattered and emitted energy,

generally decreasing the measured radiance. The emission moderated the decrease by increasing the radiance slightly. GRA

N87-18964# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
OPTICAL MEASUREMENTS WITH RELATED CHEMICAL, BIOLOGICAL AND PHYSICAL PARAMETERS FROM THE CENTRAL EQUATORIAL PACIFIC OCEAN: NOAA SHIP DISCOVERER, CRUISE RP-9-DI-84, 27 FEBRUARY - 9 MARCH 1984 Final Report
Irene P. DePalma and David F. Reid Sep. 1986 148 p
(AD-A174388; NORDA-TN-337) Avail: NTIS HC A07/MF A01 CSCL 08/10

This report summarizes data collected by NORDA's optical oceanography program on a north-south transect of the central equatorial Pacific Ocean. Data were collected from 14 stations from the surface to a depth of 2900 meters. Parameters presented here include conductivity, temperature, salinity, transmissometry, fluorometry, chlorophyll and phaeopigments, total suspended matter, particle size and nutrients (phosphate, silicate, nitrate, and nitrite). Data are reported as vertical profiles (to 250 m), temperature-salinity plots, and tables of measured and derived values. Collection and analytical procedures are also described. GRA

N87-18965# Woods Hole Oceanographic Institution, Mass.
A PERFORMANCE UPDATE OF THE INTEROCEAN S4 ELECTROMAGNETIC CURRENT METER
P. R. Clay and S. P. Longworth Oct. 1986 38 p
(Contract N00014-82-C-0019)
(AD-A174425; AD-E900637; WHOI-86-42) Avail: NTIS HC A03/MF A01 CSCL 14/2

This report reviews the working principles of the InterOcean S4 electromagnetic current meter and outlines the practical difficulties and engineering solutions to convert these basic principles into a working instrument. Presented are the test procedures and results performed on three production units placing emphasis on the oceanographic user's point of view. These tests include laboratory, dockside, and both surface and subsurface mooring tests. S4s are compared to each other to other types of current meters in various intercomparison tests. Results of this evaluation program are next summarized. Also, suggestions for areas of improvement and further developments are made. Finally, recommendations made for the acceptance, calibration, and burning in of new instruments conclude the report. GRA

N87-18966# Office of Naval Research, Arlington, Va. Ocean Sciences Div.
INVESTIGATION OF PHYSICS OF SYNTHETIC APERTURE RADAR IN OCEAN REMOTE SENSING TOWARD 84/86 FIELD EXPERIMENT. VOLUME 2: CONTRIBUTIONS OF INDIVIDUAL INVESTIGATORS Interim Report
Omar H. Shemdin May 1986 195 p
(AD-A174527) Avail: NTIS HC A09/MF A01 CSCL 17/9

Surface Gravity Wave Measurements; Development and Utilization of a Surface Energy Measurement System in Toward 84/85; Wave Follower Measurements During Toward 84/85; The Propagation of Short Surface Waves on Longer Gravity Waves; Toward Meteorology Measurements; Processing of JPL SAR Frame; Azimuthal Waves on 31 October 1984; SAR Imagery Simulated From Two Scale Radar Wave Probe Return; and Sample Predictions and Simulations of SAR Ocean Imagery are presented. GRA

N87-18967# Naval Postgraduate School, Monterey, Calif.
MIZLANT 85 DATA REPORT: RESULTS OF AN OCEANOGRAPHIC CRUISE TO THE GREENLAND SEA, SEPTEMBER 1985 Interim Report, 1 Jun. 1985 - 30 Sep. 1986
Robert H. Bourke, Robert G. Paquette, and Alan M. Weigel Sep. 1986 108 p
(AD-A174797; NPS-68-86-007) Avail: NTIS HC A06/MF A01 CSCL 08/10

This report presents plots of property profiles for each of the 156 oceanographic stations occupied by the U.S. Coast Guard icebreaker NORTHWIND in the Fram Strait area of the Greenland Sea during September 1985. A Neil Brown Mark III CTD was used to obtain temperature and salinity profiles to the sea floor in shallow water and to at least 600m in deeper water. In addition to temperature and salinity profiles, plots of sound speed and density (sigma-t) are shown. GRA

N87-18968# Sandia National Labs., Albuquerque, N. Mex.
SEAFLOOR SEISMIC DATA STUDY
D. Engi 1986 9 p Presented at the Technology Assessment and Research Program Seminar, Reston, Va., 1 Nov. 1986
(Contract DE-AC04-76DP-00789)
(DE86-005885; SAND-85-2841C; CONF-861117-1) Avail: NTIS HC A02/MF A01

A significant consideration in the design of offshore platforms, for seismically-active regions, is their response to earthquakes. However, the comprehensive inclusion of such considerations in a design activity is a formidable task. Elements of this task include characterization of projected seismicity, response of the (saturated) soils, transfer of the seismic energy from the soil to the platform, platform response to this energy deposition, and consequences associated with the platform response. A substantial amount of effort has been directed toward the synthesis of capabilities to provide these phenomenological characterizations. This effort has resulted in the development of a variety of analytical techniques. Collectively, these techniques can serve as the methodological basis for evaluation of seismic aspects pertaining to offshore platform design. Sandia National Laboratories has been involved in the design, development, installation, and interrogation of a Seafloor Earthquake Measurement System (SEMS) for nearly ten years. This R and D activity has produced an instrumentation system which is currently operating in the Shell Oil Company Beta Field, offshore Long Beach, California. The current SEMS unit (Hickerson, et al, 1986) is an upgraded version of the original unit which was also fielded offshore California. DOE

N87-18969# Melbourne Univ., Parkville (Australia). Dept. of Meteorology.
ON THE SURGING POTENTIAL OF POLAR ICE STREAMS. PART 1: SLIDING AND SURGING OF LARGE ICE MASSES, A REVIEW
B. McInnes, U. Radok, W. F. Budd, and I. N. Smith 1985 67 p
(Contract DE-AC02-84ER-60197)
(DE87-002539; DOE/ER-60197/2-Pt-1) Avail: NTIS HC A04/MF A01

The main features of glacier surges were well known by the time the first detailed glacier dynamics and ice flow law came into being during the 1950s. The surging potential of polar ice streams raises additional questions which remain to be answered by a combination of observations and model refinements. This report reviews the available evidence on glacier sliding, and the main concepts and hypotheses that have been advanced for the surging phenomenon. DOE

N87-18970# Institute of Oceanographic Sciences, Wormley (England).
SEASOAR CTD SURVEYS DURING FASINEX
R. T. Pollard, J. F. Read, and J. Smithers 1986 108 p
(IOS-230; ETN-87-99137) Avail: NTIS HC A06/MF A01

During the Frontal Air Sea Interaction Experiment (FASINEX) 5 SeaSoar runs were carried out, including a creeping line ahead survey of a 120 km x 160 km box spanning the main FASINEX front, a single box 30 km x 90 km circumnavigated 4 times in 3.75 days, and several circuits of the FASINEX mooring array, to measure CTD in the North Atlantic. Track plots using a mixture of Loran and GPS were constructed in near-real-time. ESA

N87-18971# National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Data Referral Service.
SATELLITE REMOTE SENSING OF THE MARINE ENVIRONMENT: LITERATURE AND DATA SOURCES

G. Barton, B. Roberts, and E. Riccio Jul. 1986 245 p
(PB86-245446; NEDRES-5) Avail: NTIS HC A11/MF A01 CSCL 08A

The joint NEDRES/NALIS publication presents bibliographic and data source information pertinent to remote sensing of the marine environment. Satellite oceanography has made a major contribution to knowledge of the oceans on a global scale. The bibliographic data bases searched for the publication were NALIS, NTIS, ASFA and MGA. The environmental data directory searched was NEDRES. GRA

51 LIFE SCIENCES (GENERAL)

N87-18972*# University of Southern Illinois, Carbondale. Dept. of Botany.
ORIGIN AND EVOLUTION OF OSMOREGULATORY MECHANISMS IN BLUE-GREEN ALGAE (CYANOBACTERIA) AS A FUNCTION OF METABOLIC AND STRUCTURAL COMPLEXITY: REFLECTIONS OF PRECAMBRIAN PALEOBIOLOGY Final Report, 15 Jun. 1982 - 15 May 1986
John H. Yopp, Donald R. Tindall, and Kenneth Pavlicek 11 Mar. 1987 59 p
(Grant NAGw-344)
(NASA-CR-180199; NAS 1.26:180199) Avail: NTIS HC A04/MF A01 CSCL 06C

Major accomplishments underlying the basic understanding of cyanobacterial resistance to salt tolerance and osmotic stress were made. The methodology proposed included: the tracing of the pathways of formation of osmoregulatory solutes by traditional methods involving C-14 labelled substrates; gas chromatography; amino acid analysis; X-ray analysis using scanning transmission electron microscopy; and most importantly, C-13 labelled substrates, followed by Nuclear Magnetic Resonance (NMR) spectroscopy. It was found that the cyanobacteria employ a diversity of organic, osmoregulatory solutes. Osmoregulatory solutes were found to serve four functions: adjustment of water activity, noninhibition of enzymes; lowering of K sub m of enzymes to allow functioning at normal levels when the intracellular salt accumulates, and extending the pH optimum of enzymes as intracellular pH rises due to proton-potassium ion pump action during osmoregulation. Differences in osmoregulatory solutes may, but are not always, be attributed to differences in nutritional capabilities. The mechanism of osmoregulation and concomitant salt tolerance in halophilic cyanobacteria was elucidated. The activities of betaine and S-Adenosylhomocysteine hydrolase are discussed. B.G.

N87-18973*# Management and Technical Services Co., Washington, D.C.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 10
Lydia Razran Hooke, Mike Radtke, Ronald Teeter, Victoria Garshnek, and Joseph E. Rowe (Library of Congress, Washington, D. C.) Washington NASA Mar. 1987 110 p
(Contract NASw-3676)
(NASA-CR-3922(12); NAS 1.26:3922(12)) Avail: NTIS HC A06/MF A01 CSCL 06C

The USSR Space Life Sciences Digest contains abstracts of 37 papers recently published in Russian language periodicals and bound collections and of five new Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. Additional features include the translation of a book chapter concerning use of biological rhythms as a basis for cosmonaut selection, excerpts from the diary of a participant in a long-term isolation experiment, and a picture and description of the Mir space station. The abstracts included in this issue were identified as relevant to 25 areas of aerospace medicine and space biology. These areas are adaptation, biological rhythms, biospherics, body fluids, botany, cardiovascular and respiratory systems, developmental biology, endocrinology, enzymology, group dynamics, habitability and environmental effects, hematology, human performance, immunology, life support systems, mathematical modeling, metabolism, microbiology, morphology and cytology, musculosketal system, neurophysiology, nutrition, personnel selection, psychology, and radiobiology. Author

N87-18974# Missouri Univ., Columbia. Dept. of Biological Sciences.
PHOTOSYNTHESIS, CLONING AND BIOCONVERSION OF SOLAR ENERGY IN CYANOBACTERIA Final Report, 1 May 1983 - 30 Apr. 1986
L. A. Sherman Jun. 1986 17 p
(Contract DE-AC02-81ER-10899)
(DE86-015846; DOE/ER-10899/T1) Avail: NTIS HC A02/MF A01

This project is concerned with an analysis of the photosynthetic membrane in the cyanobacterium, Aphanocapsa sp. The first stage of the project concerned an analysis of the membrane proteins, including pigment-binding proteins, and analysis of the composition of PSII, PSI, cyt b sub 6/f complex, and phycobilisomes. These complexes were analyzed by biochemical separation of the complexes, gel electrophoresis, and western blotting using heterologous antibodies. Some novel membrane proteins were detected and were isolated from acrylamide gels. Antibodies against these proteins were produced and utilized to clone the genes from a lambda gtll library. The genes for two of the proteins, a 36 kDa chlorophyll-binding proteins and a 42 kDa carotenid-binding protein have been cloned and sequenced. This system is being utilized because of the ability to exchange genetic information in cyanobacteria. In addition to transformation, we developed a conjugation system that allows introduction of large plasmids from bacteria into Aphanocapsa. We are using this and other genetic exchange methods to produce specific mutations in cyanobacteria to determine the function of protein and protein domains. DOE

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N87-18975* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 295)
Mar. 1987 71 p
(NASA-SP-7011(295); NAS 1.21:7011(295)) Avail: NTIS HC A04 CSCL 06E

This bibliography lists 206 reports, articles and other documents introduced into the NASA scientific and technical information system in February, 1987. Author

N87-18976* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CUMULATIVE INDEX TO THE 1986 ISSUES (SUPPLEMENT 293)
Jan. 1987 251 p
(NASA-SP-7011(293); NAS 1.21:7011(293)) Avail: NTIS HC A12 CSCL 06E

This publication is a cumulative index to the abstracts contained in the Supplements 281 through 292 of Aerospace Medicine and Biology: A Continuing Bibliography. It includes seven indexes - subject, personal author, corporate source, foreign technology, contract number, report number, and accession number. Author

N87-18977*# Brown Univ., Providence, R. I. Dept. of Pathology.
GROWTH FACTOR INVOLVEMENT IN TENSION-INDUCED SKELETAL MUSCLE GROWTH Semiannual Status Report, Sep. 1986 - Mar. 1987
Herman W. Vandenburgh 1987 8 p Prepared in cooperation with Miriam Hospital, Providence, R.I.
(Grant NAG2-414)

(NASA-CR-180201; NAS 1.26:180201) Avail: NTIS HC A02/MF A01 CSCL 06P

New muscle tissue culture techniques were developed to grow embryonic skeletal myofibers which are able to differentiate into more adultlike myofibers. Studies on mechanical simulation of cultured muscle cell growth will now be more directly applicable to mechanically-induced growth in adult muscle, and lead to better models for understanding muscle tissue atrophy caused by disuse in the microgravity of space. Author

N87-18978*# California Univ., San Francisco. Dept. of Physiology.

NEURAL MECHANISMS BY WHICH GRAVITATIONAL STIMULI AND STRESS AFFECT THE SECRETION OF RENIN AND OTHER HORMONES Final Technical Report

William F. Ganong 26 Mar. 1987 4 p

(Grant NAGw-490)

(NASA-CR-180246; NAS 1.26:180246) Avail: NTIS HC A02/MF A01 CSCL 06S

The present goal is to determine by the production of discrete lesions the parts of the hypothalamus and brainstem that are involved in serotonin-mediated increases in renin secretion. A variety of stimuli which act in different ways to increase renin stimuli were developed and standardized. The experiments with p-chloroamphetamine (PCA) demonstrated that there is a serotonergic pathway which projects from the dorsal raphe nuclei to the paraventricular nuclei and the vetromedial nuclei of the hypothalamus; that projection from paraventricular nuclei to the brainstem and spinal cord may be oxytocinergic; and that the pathway from the spinal cord to the renin secreting cells is sympathetic. The demonstration that paraventicular lesions lower circulating renin substrate is important because it raises the possibility that substrate secretion is under neural control, either via the pituitary or by direct neural pathways. The discovery that lesions of the ventromedial nuclei appear to abolish the increase in renin secretion produced by many different stimuli without affecting the concentration of renin substrate in the plasma makes the position of the hypothalamus in the regulation of fluid and electrolyte balance more prominent than previously suspected. B.G.

N87-18979*# California Univ., San Diego, La Jolla. Dept. of Chemistry.

THIOL BIOCHEMISTRY OF PROKARYOTES Final Technical Report, 7 Jun. 1982 - 31 Dec. 1986

Robert C. Fahey 31 Dec. 1986 5 p

(Grant NAGw-342)

(NASA-CR-180257; NAS 1.26:180257) Avail: NTIS HC A02/MF A01 CSCL 06P

The present studies have shown that GSH metabolism arose in the purple bacteria and cyanobacteria where it functions to protect against oxygen toxicity. Evidence was obtained indicating that GSH metabolism was incorporated into eucaryotes via the endosymbiosis giving rise to mitochrondria and chloroplasts. Aerobic bacteria lacking GSH utilize other thiols for apparently similar functions, the thiol being coenzyme A in Gram positive bacteria and chi-giutamylcysteine in the halobacteria. The thiol biochemistry of prokaryotes is thus seen to be much more highly diversified than that of eucaryotes and much remains to be learned about this subject. B.G.

N87-18980# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

APPARENT MOTION AND PRIOR CORRESPONDENCE EFFECTS IN VISUAL PERCEPTION

Robert G. Eggleston Jun. 1986 164 p

(AD-A174424; AD-E900637; AAMRL-TR-86-027) Avail: NTIS HC A08/MF A01 CSCL 05/10

The process by which two visual stimuli presented at one time (t1) are paired with two different stimuli presented at a later time (t2) was investigated. Since there was more than one way for the stimuli to mate across frames, the task involved a problem in correspondence. It was proposed that the solution to a correspondence problem would be influenced (1) by the solution to the immediately preceding, or prior, one, and (2) by variations in the spatio-temporal characteristics of the sequentially presented apparent movement displays. When the prior and current correspondence problems were identical in structure, the influence of the former problem on the latter one was called a hysteresis effect; when the two problems were not identical in structure, the interaction between problems was called a priming effect. The results of eight experiments showed that (1) the hysteresis effect and priming effects were significant, and (2) the magnitude of both effects was related to the spatio-temporal parameters of the display sequence. In addition, both effects can operate in a telegraphic mode , can tolerate a difference in the type of solution between the prior and current problems, and more recent correspondence problems have a larger prior correspondence effect than more frequent but less recent correspondence problems. GRA

N87-18981# Oak Ridge National Lab., Tenn.

MODELLING EARLY STAGES OF HUMAN VISION

C. C. Jorgensen, R. Gawronski, and F. Holly Aug. 1986 133 p Prepared in cooperation with Army Human Engineering Labs., Aberdeen Proving Ground, Md.

(Contract DE-AC05-84OR-21400)

(DE86-015996; ORNL/TM-10031) Avail: NTIS HC A07/MF A01

This report presents the first results of an effort to model vision processes operating in the early layers of the human retina. The ultimate goal of this research is to develop a robot vision system based on computational principles of human vision. These include massive parallelism, dynamic feedback, and multilayer pattern recognition. Two neural models were developed. The first represented early vision in terms of static two-dimensional linear equations using a linear matrix and limited feedback. The second considered dynamic two-dimensional nonlinear processes and used matrices of nonlinear differential equations. The first set of equations was parameterized using psychophysical data from subjective intensity judgements for visual illusions. Illusions were quantified by creating a digitized image representing the subjective effect of human perception when exposed to input patterns. A Fourier transform was made of the input and output patterns and used to solve for the coefficients of the retinal operator equations. The equations were then applied to new illusions and compared with human subjective results through three dimensional plots of output pixel intensities. The second model with dynamic equations was studied using a computer simulation developed to operate on varying input wave forms and variable neural connection topologies. DOE

N87-18982# Oak Ridge National Lab., Tenn.

DOSE-RATE MODELS FOR HUMAN SURVIVAL AFTER EXPOSURE TO IONIZING RADIATION

T. D. Jones, M. D. Morris, and R. W. Young (Defense Nuclear Agency, Washington, D.C.) 1986 9 p Presented at the American Nuclear Society Annual Meeting, Bethesda, Md., 15 Sep. 1986 Prepared in cooperation with Defense Nuclear Agency, Washington, D.C.

(Contract DE-AC05-84OR-21400)

(DE86-015645; CONF-8609147-1) Avail: NTIS HC A02/MF A01

This paper reviews new estimates of the LD sub 50 in man by Mole and by Rotblat, the biological processes contributing to hematologic death, the collection of animal experiments dealing with hematologic death, and the use of regression analysis to make new estimates of human mortality based on all relevant animal studies. Regression analysis of animal mortality data has shown that mortality is dependent strongly on dose rate, species, body weight, and time interval over which the exposure is delivered. The model has predicted human LD sub 50s of 194, 250, 310, and 360 rad to marrow when the exposure time is a minute, an hour, a day, and a week, respectively. DOE

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

No abstracts in this category.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N87-18983*# Texas A&M Univ., College Station. Regenerative Concepts Group.

CONCEPTUAL DESIGN FOR A FOOD PRODUCTION, WATER AND WASTE PROCESSING, AND GAS REGENERATION MODULE Semiannual Progress Report

O. W. Nicks 15 Nov. 1986 97 p

(Grant NAG9-161)

(NASA-CR-180208; NAS 1.26:180208; SRC-5494-1) Avail: NTIS HC A05/MF A01 CSCL 06K

During the first six month period, the RECON (Regenerative Concepts Group) team collected reference material, made visits to consult with other researchers, and invited distinguished visitors to speak on the status of closed life support activities. A decision was made to develop the data base and modeling such that artificial intelligence (AI) methods could be used to manipulate data and examine concept alternatives. Six discrete tasks and a project schedule were outlined for the first year. The first two tasks have been essentially completed and have resulted in a sample set of assumptions for general use in defining candidate systems and for the specification of closed system characteristics. To model a closed environment, decisions were necessary to establish the amounts of food, air, water and waste products. Although recognized that data would eventually be normalized on the basis of a single human, the amount of data in existence for four person crews led to the decision to use this as a baseline. Information on existing concepts was collected from NASA sources, from industry, and libraries. Concept modeling was begun, hardware and software obtained, technical tasks identified and experimental work initiated. Author

N87-18984*# Grumman Aerospace Corp., Bethpage, N.Y. Space Systems Div.

TELEROBOTIC ASSEMBLY OF SPACE STATION TRUSS STRUCTURE

Grahme Fischer [1986] 10 p Presented at the 1986 Space Telerobotics Workshop, Pasadena, Calif., 20-22 Jan. 1987

(Contract NAS9-17229)

(NASA-CR-180239; NAS 1.26:180239) Avail: NTIS HC A02/MF A01 CSCL 05H

Discussed are methods of assembling the space station's structure utilizing only telerobotic devices, i.e.: (1) an approximately anthropomorphic telerobot with two dextrous arms; (2) the Shuttle Remote Manipulator System (SRNS); (3) various material handling machines. Timelines and task recommendations for autonomous operations are also included. Also described are some experimental results comparing two manipulator control devices. Author

N87-18985*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

STEREO DEPTH DISTORTIONS IN TELEOPERATION

Daniel B. Diner and Marika vonSydow 1 Feb. 1987 54 p

(Contract NAS7-918)

(NASA-CR-180242; JPL-PUB-87-1; NAS 1.26:180242) Avail: NTIS HC A04/MF A01 CSCL 05H

In teleoperation, a typical application of stereo vision is to view a work space located short distances (1 to 3 meters) in front of the cameras. Discussed are converged camera placement and the effects of intercamera distance, camera-to-object viewing distance, and focal length of the camera lenses on both stereo depth resolution and stereo depth distortion. While viewing the fronto-parallel plane 1.3 meters in front of the cameras, depth errors on the order of 2 centimeters are measured. A geometric analysis was made of the distortion of the fronto-parallel plane of convergence for stereo TV viewing. Results were then verified experimentally. The objective was to determine the optimal camera configuration which gave high stereo depth resolution while minimizing stereo depth distortion. It was found that for converged cameras at a fixed camera-to-object viewing distance, larger intercamera distances allow higher depth resolutions, but cause greater depth distortions. Thus with larger intercamera distances, operators will make greater depth errors (because of the greater distortions), but will be more certain that they are not errors (because of the higher resolution). The analysis predicts camera configurations and a camera motion strategy that minimize stereo depth distortion without sacrificing stereo depth resolution. Author

N87-18986# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

ALTERNATING-FIELD STEREOSCOPIC DISPLAYS USING LIGHT-SCATTERING LIQUID CRYSTAL SPECTACLES

P. Milgram and R. vanderHorst 4 Dec. 1985 20 p Submitted for publication

(NLR-MP-85083-U; ETN-87-99297) Avail: NTIS HC A02/MF A01

Field-sequential stereoscopy means of displaying three dimensional visual images are reviewed. The conventional electro-optic shutter devices used for viewing such displays employ either twisted nematic liquid crystals or PLTZ ceramics. Both of these methods suffer the drawback of severe reduction in the brightness of the display image being observed. A field sequential stereoscopic viewing apparatus employing light-scattering cholesteric liquid crystals is proposed. Advantages of this device include minimal reduction in image brightness, full color, and reduced visual fatigue. ESA

N87-18987# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

IMPROVED GUIDANCE AND CONTROL AUTOMATION AT THE MAN-MACHINE INTERFACE

Walter M. Hollister, ed. Dec. 1986 123 p

(AGARD-AR-228; ISBN-92-835-1537-4) Avail: NTIS HC A06/MF A01

Modern control and display technology has already reduced significantly the workload associated with piloting all forms of airborne vehicles. However, increased demands on the pilot make it desirable to establish how automation may further reduce both the cognitive and desision-making workload of the pilot. There is evidence that under high workload, in poor visibility, or for maximum combat capability, the pilot could perform better with control inputs more directly related to the outputs over which he needs control. There are also basic questions as to what information the pilot really needs, what control and management functions can be automated, and what functions must the pilot retain to perform his task satisfactorily in relation to different mission aspects. The AGARD GCP/WG.07 members were asked to identify the most promising options for improved automation at the man-machine interface of flight vehicles and present their findings. Author

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N87-18988*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONCURRENT EXTENSIONS TO THE FORTRAN LANGUAGE FOR PARALLEL PROGRAMMING OF COMPUTATIONAL FLUID DYNAMICS ALGORITHMS
Cindy Lou Weeks Sep. 1986 29 p
(NASA-TM-88363; A-86414; NAS 1.15:88363) Avail: NTIS HC A03/MF A01 CSCL 09B

Experiments were conducted at NASA Ames Research Center to define multi-tasking software requirements for multiple-instruction, multiple-data stream (MIMD) computer architectures. The focus was on specifying solutions for algorithms in the field of computational fluid dynamics (CFD). The program objectives were to allow researchers to produce usable parallel application software as soon as possible after acquiring MIMD computer equipment, to provide researchers with an easy-to-learn and easy-to-use parallel software language which could be implemented on several different MIMD machines, and to enable researchers to list preferred design specifications for future MIMD computer architectures. Analysis of CFD algorithms indicated that extensions of an existing programming language, adaptable to new computer architectures, provided the best solution to meeting program objectives. The CoFORTRAN Language was written in response to these objectives and to provide researchers a means to experiment with parallel software solutions to CFD algorithms on machines with parallel architectures. Author

N87-18989# Naval Sea Systems Command, Washington, D.C. Office of the Chief Engineer for Logistics.
ENGINEERING MANAGEMENT APPLICATIONS OF COMPUTERS AND DATA PROCESSING
Joyce DeTolla and Joseph P. DeTolla 4 Apr. 1986 16 p Presented at the 23rd Annual Technical Symposium, Washington, D.C., 1986
(AD-A174040) Avail: NTIS HC A02/MF A01 CSCL 09/2

As computer technology and all that it encompasses have expanded through the years, several areas of specialization have appeared. From a user's viewpoint, some of these specialties are: computer aided design, computer aided manufacturing, computer aided instruction, and document processing systems. Very fundamentally, the computer which serves as the basis for these specialties remains the same. The commands given to the computer, the functions it carries out, and the output it provides are tailored to the needs of various user groups. However, specialization has resulted in polarizing of the users. This paper briefly explores areas of computer applications and relates examples which the authors see as obstacles to an integrated ADP system. A survey of computer systems planning and design is presented from the organizational perspective. The paper offers a summary of general issues of software applications, and concludes with views on training as part of the overall computer system implementation process in a large, specialized organization. GRA

N87-18990# Argonne National Lab., Ill. Mathematics and Computer Science Div.
SURVEY OF HIGH PERFORMANCE COMPUTERS
J. J. Dongarra 1986 6 p Presented at the Spring COMPCON, San Francisco, Calif., 3 Mar. 1986
(Contract W-31-109-eng-38)
(DE86-014538; CONF-860398-1) Avail: NTIS HC A02/MF A01

Supercomputers are classified according to their cost and architecture. A distinction is made between machines costing greater than or less than one million dollars. Architectures are first divided into scalar, vector, and parallel machines and then subdivided according to memory allocation and data bus characteristics. DOE

N87-18991# Palermo Univ. (Italy). Dipartimento di Matematica e Applicazioni.
OVERVIEW ON PYRAMID MACHINES FOR IMAGE PROCESSING
V. DiGesu Aug. 1986 12 p Presented at the 2nd International Conference on Advances in Pattern Recognition and Digital Techniques, Calcutta, India, 6 Jan. 1986 Prepared in cooperation with Stanford Linear Accelerator Center, Menlo Park, Calif.
(Contract DE-AC03-76SF-00515)
(DE86-015812; SLAC-PUB-4059; CONF-860186-1) Avail: NTIS HC A02/MF A01

This paper is intended to review the existing hierarchical multiprocessor machines dedicated to Image Processing (IP). Some general design concepts are given and compared in terms of hardware and software complexity. DOE

N87-18992# National Bureau of Standards, Gaithersburg, Md. Center for Computer Systems Engineering.
NATIONAL BUREAU OF STANDARDS WORKSHOP ON PERFORMANCE EVALUATION OF PARALLEL COMPUTERS
S. B. Salazar and C. H. Smith Jul. 1986 51 p Workshop held in Gaithersburg, Md., 5-6 Jun. 1985
(PB86-244175; NBSIR-86/3395) Avail: NTIS HC A04/MF A01 CSCL 09B

The Systems Components Division of the Institute for Computer Sciences and Technology at the National Bureau of Standards is actively engaged in the development of techniques to measure and evaluate the performance of parallel computers. As a preliminary step, a workshop on performance evaluation was held in Gaithersburg, Maryland on June 5th and 6th, 1985. The goal of the workshop was to define the issues and problems involved in the development of benchmarks for large parallel computers. Thirty-six talks were given by representatives of government, industries, universities and research laboratories. The topics presented ranged from specific measurements of large parallel machines to the philosophical issues concerned with the development of universally applicable benchmarks. The document is a report on the workshop. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

N87-18993*# Textron Bell Helicopter, Fort Worth, Tex.
DEVELOPMENT OF A ROT22 - DATAMAP INTERFACE

K. R. Shenoy, T. Waak, and J. T. Brieger Apr. 1986 105 p
(Contract NAS2-10331)
(NASA-CR-177403; NAS 1.26:177403) Avail: NTIS HC A06/MF A01 CSCL 09B

This report (Contract NAS2-10331- Mod 10), outlines the development and validation of an interface between the three-dimensional transonic analysis program ROT22 and the Data from Aeromechanics Test and Analytics-Management and Analysis Package (DATAMAP). After development of the interface, the validation is carried out as follows. First, the DATAMAP program is used to analyze a portion of the Tip Aerodynamics and Acoustics Test (TAAT) data. Specifically, records 2872 and 2873 are analyzed at an azimuth of 90 deg, and record 2806 is analyzed at 60 deg. Trim conditions for these flight conditions are then calculated using the Bell performance prediction program ARAM45. Equivalent shaft, pitch, and twist angles are calculated from ARAM45 results and used as input to the ROT22 program. The interface uses the ROT22 results and creates DATAMAP information files from which the surface pressure contours and sectional pressure coefficients are plotted. Twist angles input to ROT22 program are then iteratively modified in the tip region until the computed pressure coefficients closely match the measurements. In all cases studied, the location of the shock is well predicted. However, the negative pressure coefficients were underpredicted. This could be accounted for by blade vortex interaction effects. Author

N87-18994*# TRW Defense Systems Group, Houston, Tex. Systems Engineering and Analysis Dept.
ORBITAL FLIGHT SIMULATION UTILITY SOFTWARE UNIT SPECIFICATIONS, REVISION 1
S. W. Wilson 30 Sep. 1986 205 p
(Contract NAS9-17554)
(NASA-CR-171959; NAS 1.26:171959;
TRW-47467-H005-UX01-Rev-1) Avail: NTIS HC A10/MF A01 CSCL 09B

The HP PASCAL source code defines the specifications for a Utility Software Unit (USU) designed to support orbital flight simulators such as MANHANDLE and GREAS (General Research and Engineering Analysis Simulator). Besides providing basic input/output, mathematical, matrix, quaternion, and statistical routines for such simulators, one of the primary functions of the USU is to isolate all system-dependent codes in one well-defined compartment, thereby facilitating transportation of the simulations from one computer to another. Directives are given for the PASCAL compilers of the HP-9000 Series 200 Pascal 3.0 and the HP-9000 Series 500 HP-UX 5.0 operating systems that produce a single file of relocatable code from four separate files of source code. Three of the source code files are common to both operating systems. The fourth source code file (utilspif.l) contains all of the system-dependent PASCAL code for the USU. A fifth file of source code written in C is required to interface utilspif.l with the HP-UX I/O package. The Pascal 3.0 compiler directives and the driver source code for a unit rest program and counterparts for the HP-UX 5.0 operating system are given. The major portion of the unit test program source code is common to both operating systems. Unit test results from the Pascal 3.0 operating system and results from the HP-UX operating system are given. Author

N87-18995*# Texas Univ., Austin. Large Scale Programs Inst.
A DEMONSTRATIVE MODEL OF A LUNAR BASE SIMULATION ON A PERSONAL COMPUTER
15 Mar. 1985 128 p
(Grant NAG9-116)
(NASA-CR-171976; NAS 1.26:171976) Avail: NTIS HC A07/MF A01 CSCL 09B

The initial demonstration model of a lunar base simulation is described. This initial model was developed on the personal computer level to demonstrate feasibility and technique before proceeding to a larger computer-based model. Lotus Symphony Version 1.1 software was used to base the demonstration model on an personal computer with an MS-DOS operating system. The personal computer-based model determined the applicability of lunar base modeling techniques developed at an LSPI/NASA workshop. In addition, the personnal computer-based demonstration model defined a modeling structure that could be employed on a larger, more comprehensive VAX-based lunar base simulation. Refinement of this personal computer model and the development of a VAX-based model is planned in the near future. Author

N87-18996*# Inference Corp., Los Angeles, Calif.
AUTOMATED SOFTWARE DEVELOPMENT WORKSTATION Final Report
4 Dec. 1986 59 p
(Contract NAS9-17515)
(NASA-CR-180200; NAS 1.26:180200) Avail: NTIS HC A04/MF A01 CSCL 09B

Engineering software development was automated using an expert system (rule-based) approach. The use of this technology offers benefits not available from current software development and maintenance methodologies. A workstation was built with a library or program data base with methods for browsing the designs stored; a system for graphical specification of designs including a capability for hierarchical refinement and definition in a graphical design system; and an automated code generation capability in FORTRAN. The workstation was then used in a demonstration with examples from an attitude control subsystem design for the space station. Documentation and recommendations are presented. B.G.

N87-18997*# Cornell Univ., Ithaca, N.Y.
COLOR POSTPROCESSING FOR 3-DIMENSIONAL FINITE ELEMENT MESH QUALITY EVALUATION AND EVOLVING GRAPHICAL WORKSTATION
Malcolm J. Panthaki Mar. 1987 188 p Original document contains color illustrations
(Grant NAG3-395)
(NASA-CR-180215; NAS 1.26:180215; PCG-Rept-87-1) Avail: NTIS HC A09/MF A01 CSCL 09B

Three general tasks on general-purpose, interactive color graphics postprocessing for three-dimensional computational mechanics were accomplished. First, the existing program (POST-PRO3D) is ported to a high-resolution device. In the course of this transfer, numerous enhancements are implemented in the program. The performance of the hardware was evaluated from the point of view of engineering postprocessing, and the characteristics of future hardware were discussed. Second, interactive graphical tools implemented to facilitate qualitative mesh evaluation from a single analysis. The literature was surveyed and a bibliography compiled. Qualitative mesh sensors were examined, and the use of two-dimensional plots of unaveraged responses on the surface of three-dimensional continua was emphasized in an interactive color raster graphics environment. Finally, a postprocessing environment was designed for state-of-the-art workstation technology. Modularity, personalization of the environment, integration of the engineering design processes, and the development and use of high-level graphics tools are some of the features of the intended environment. Author

N87-18998*# Cornell Univ., Ithaca, N.Y.
UNIFICATION OF COLOR POSTPROCESSING TECHNIQUES FOR 3-DIMENSIONAL COMPUTATIONAL MECHANICS
Bruce Charles Bailey Aug. 1985 143 p
(Grant NAG3-395)
(NASA-CR-180214; NAS 1.26:180214; PCG-Rept-85-1) Avail: NTIS HC A07/MF A01 CSCL 09B

To facilitate the understanding of complex three-dimensional numerical models, advanced interactive color postprocessing techniques are introduced. These techniques are sufficiently flexible so that postprocessing difficulties arising from model size, geometric complexity, response variation, and analysis type can be adequately overcome. Finite element, finite difference, and boundary element models may be evaluated with the prototype

postprocessor. Elements may be removed from parent models to be studied as independent subobjects. Discontinuous responses may be contoured including responses which become singular, and nonlinear color scales may be input by the user for the enhancement of the contouring operation. Hit testing can be performed to extract precise geometric, response, mesh, or material information from the database. In addition, stress intensity factors may be contoured along the crack front of a fracture model. Stepwise analyses can be studied, and the user can recontour responses repeatedly, as if he were paging through the response sets. As a system, these tools allow effective interpretation of complex analysis results. Author

N87-18999# British Aerospace Aircraft Group, Preston (England). Math Services Dept.

THE POSSIBLE REPLACEMENT OF CSMP 3 BY DSL/VS

C. A. Jones Jun. 1985 32 p

(BAE-MSC.104; ETN-86-96562) Avail: NTIS HC A03/MF A01

The withdrawal of support for CSMP 3 by IBM led to a study of the possibility of replacing it by a package known as DSL/VS. It is concluded that although DSL/VS and CSMP 3 are similar enough to allow programs and datasets written for CSMP to be automatically converted to a form suitable for DSL/VS, there is an input model size restriction implicit to DSL/VS that may prevent the total removal of CSMP 3. Author (ESA)

N87-19000*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

TAVERNS AND THE SPACE STATION SOFTWARE SUPPORT ENVIRONMENT

Norman R. Howes (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.) and Gary K. Raines 1987 6 p Proposed for presentation at the ADA Europe 87 Conference, Stockholm, Sweden, 26-28 May 1987

(NASA-TM-89280; NAS 1.15:89280) Avail: NTIS HC A02/MF A01 CSCL 09B

The Space Station Information System (SSIS) provides the data processing capability for the Space Station Program (SSP). The Software Support Environment (SSE) System for the SSP is the collection of software, procedures, standards, hardware specification, documentation, policy, and training materials. The Ada programming language was baselined by the Space Station Program Office as the language for development and maintenance of all space station software including the software of the SSE itself. The Test And Validation Environment for Remote Networked Systems (TAVERNS) is a distributed philosophy for development and validation of Ada applications software for the space station and as such is closely related to the SSE. An overview of the system is provided. B.G.

N87-19001*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AKPLOT: A PLOTTER ROUTINE FOR IBM PC, XT AND AT

Anil Kantak 15 Feb. 1987 38 p

(Contract NAS7-918)

(NASA-CR-180240; JPL-PUB-87-3; NAS 1.26:180240) Avail: NTIS HC A03/MF A01 CSCL 09B

The AKPLOT software for the IBM PC, XT, and AT is an efficient and versatile tool that allows X-Y plotting of quantitative information. Features include IBM four-color graphics, which combined with 10 different symbols allows 40 different curves on the same grid, shrink or expansion of the graph size, any combination of log and linear X and Y axes, selective plotting from multiple curves of a previous run, interpolation and polynomial least-squares fit with any degree polynomial, and a 90-degree tilt of the entire graph. These options are independent, and can be invoked individually. Author

N87-19002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AUTOMATING THE PARALLEL PROCESSING OF FLUID AND STRUCTURAL DYNAMICS CALCULATIONS

Dale J. Arpasi and Gary L. Cole 1987 11 p Prepared for presentation at the Summer Computer Simulation Conference, Montreal, Quebec, 27-30 Jul., 1987; sponsored by the Society for Computer Simulation

(NASA-TM-89837; E-3494; NAS 1.15:89837) Avail: NTIS HC A02/MF A01 CSCL 09B

The NASA Lewis Research Center is actively involved in the development of expert system technology to assist users in applying parallel processing to computational fluid and structural dynamic analysis. The goal of this effort is to eliminate the necessity for the physical scientist to become a computer scientist in order to effectively use the computer as a research tool. Programming and operating software utilities have previously been developed to solve systems of ordinary nonlinear differential equations on parallel scalar processors. Current efforts are aimed at extending these capabilities to systems of partial differential equations, that describe the complex behavior of fluids and structures within aerospace propulsion systems. This paper presents some important considerations in the redesign, in particular, the need for algorithms and software utilities that can automatically identify data flow patterns in the application program and partition and allocate calculations to the parallel processors. A library-oriented multiprocessing concept for integrating the hardware and software functions is described. Author

N87-19003# McLean Research Center, Inc., Va.

EXPERT SYSTEM FOR SOFTWARE QUALITY ASSURANCE Final Report, Apr. - Oct. 1986

William E. Baum, Judith Podell, and G. N. Romstedt 12 Nov. 1986 189 p

(Contract DAAK70-84-D-0052)

(AD-A173993) Avail: NTIS HC A09/MF A01 CSCL 09/2

This report describes the development of an expert system for software quality assurance (SQA). The expert system was designed to facilitate the process of tailoring statements of work by capturing the knowledge of SQA engineers. This task was undertaken in order to alleviate the problems of staff turnover and inexperience and to ensure that the standards and requirement of an adequate SQA Program are enforced, thereby improving the level of performance of the BRDEC SQA mission. GRA

N87-19004# Dayton Univ., Ohio.

EXTENSION AND APPLICATION OF A PROCEDURE FOR DAMAGE ASSESSMENT OF AEROSPACE STRUCTURES Final Report, May 1984 - Nov. 1985

R. F. Taylor, R. A. Brockman, and V. G. Dominic Sep. 1986 89 p

(Contract F33615-84-C-3406)

(AD-A174035; UDR-TR-86-03; AFWAL-TR-86-3047) Avail: NTIS HC A05/MF A01 CSCL 01/3

This report documents the extension and application of a computer code for the Automated Design of Damage RESistant Structures (ADDRESS). The program is operable on the VAX-11/780 computer system under the VMS operating system. Extensions to the code over previous work includes the automated selection of damage locations via a sensitivity analysis, linking of design variables for more realistic damage tolerant member sizes, the introduction of standard material sizes in the output design, and the incorporation of a Sturm sequence check for determining frequencies in a given range. Applications are made to typical finite element models of lifting surfaces and to truss structures to validate the code for larger problems. By use of a setup procedure special purpose versions of the code can be made which include user specified upper bounds for key variables such as total number of nodes, elements, and degrees of freedom. Disk storage is the only limiting factor for large problems, rather than program dimension specifications. All large-scale calculations are performed out of core. GRA

N87-19005# Sandia National Labs., Albuquerque, N. Mex. Engineering Analysis Dept.

SUPES: A SOFTWARE UTILITIES PACKAGE FOR THE ENGINEERING SCIENCES

D. P. Flanagan, W. C. Mills-Curran, and L. M. Taylor Sep. 1986

61 p
(Contract DE-AC04-76DP-00789)
(DE86-015749; SAND-86-0911) Avail: NTIS HC A04/MF A01

The Software Utilities Package for the Engineering Sciences (SUPES) is a collection of FORTRAN subprograms which perform frequently used nonnumerical services for the engineering applications programmer. The three functional categories of SUPES are: (1) input command parsing, (2) dynamic memory management, and (3) system dependent utilities. The subprograms in categories one and two are written in standard FORTRAN-77, while the subprograms in category three are written to provide a standardized FORTRAN interface to several system dependent features. DOE

N87-19006# Lawrence Livermore National Lab., Calif.
GEOMETRY DEFINITION WITH MAZE
H. E. Nebeck. Aug. 1986 45 p
(Contract W-7405-eng-48)
(DE86-016046; UCID-20850) Avail: NTIS HC A03/MF A01

The MAZE mesh generator represents an arbitrary two dimensional region of space as an ordered collection of quadrilateral elements. Each element is defined by its four corner points (nodes) and an integer material number. Models are created by subdividing the region(s) of interest into one or more parts and specifying the element distribution in each part. Then, parts can be merged together to form the meshed representation of the entire region. Applying boundary conditions and describing material properties completes the model construction process. This activity takes place in three distinct phases: phase 1-define geometry, subdivide regions into elements; phase 2-refine geometry, establish interface and boundary conditions; phase 3-describe material properties. This work presents explanations and examples of the phase 1 commands, along with an overview of the MAZE mesh generation process. DOE

N87-19007# Sandia National Labs., Albuquerque, N. Mex. CAD/CAM Integration Div.
CADCAM 024. DOEDEF KERNEL USER'S GUIDE, VERSION 1.3
A. L. Ames Sep. 1986 60 p
(Contract DE-AC04-76DP-00789)
(DE86-016055; SAND-85-2307) Avail: NTIS HC A04/MF A01

The Department of Energy Data Exchange Format (DOEDEF) Subgroup is developing a software environment for effective translation of CAD based product definition between dissimilar CAD systems within the DOE Weapons Complex based on the Initial Graphics Exchange Specification (IGES). The DOEDEF KERNEL is a set of callable procedures and functions which support the writing of procedures for modifying IGES-based CAD data in a RIM database. This document describes the interface to the procedures within KERNEL. DOE

N87-19008# Argonne National Lab., Ill.
NATIONAL ENERGY SOFTWARE CENTER: COMPILATION OF SOFTWARE ABSTRACTS, VOLUME 2, SUPPLEMENT 2, REVISION
M. Birgersson, M. K. Butler, J. Carter, M. M. DeBruler, F. K. Degges, C. E. Eyberger, L. R. Eyberger, P. L. Johnson, and L. L. Reed Mar. 1986 692 p
(Contract W-31-109-eng-38)
(DE86-009831; ANL-7411-Vol-2-Suppl-2-Rev) Avail: NTIS HC A99/MF A01

The abstract collection is listed in alphabetical order and also arranged into broad subject areas (chemistry, physics, materials, etc.). Each abstract consists of an identification and title, the computer for which the software was written, other machine versions available, a description of the problem which the software is designed to solve, restrictions on the complexity of the problem, timing, unusual features of the software, related and auxiliary software requirements, status, references, programming languages, operating systems, other programming or operating information or restrictions, name and establishment of author or contributor, material available, keywords, and sponsor. This is the second of two volumes. DOE

N87-19009# Brookhaven National Lab., Upton, N. Y.
FUZZY SYSTEM MODEL ON AN IBM pc
A. M. Thorndike 1986 16 p Presented at the ACM Conference on Personal and Small Computers, San Francisco, Calif., 3 Dec. 1986
(Contract DE-AC02-76CH-00016)
(DE86-012711; BNL-38241; CONF-861215-1) Avail: NTIS HC A02/MF A01

An explanation is given of the term fuzzy sets. Arithmetic conventions for dealing with fuzzy numbers are presented. The implementation of a fuzzy model of tree growth by a computer program named FUZAR is discussed. DOE

N87-19010# Oak Ridge National Lab., Tenn.
RT-11 FORTRAN SUBROUTINES FOR X-Y PLOTTING ON HEWLETT-PACKARD 7470A/7475A GRAPHICS PLOTTERS
D. E. Goeringer Aug. 1986 27 p
(Contract DE-AC05-84OR-21400)
(DE87-001605; ORNL/TM-10148) Avail: NTIS HC A03/MF A01

A package of FORTRAN IV subroutines has been developed for x-y plotting with Hewlett-Packard 7470A/7475A graphics plotters on Digital Equipment Corporation PDP-11 series computers running the RT-11 operating system. This report describes the function of each subroutine in detail, gives examples of their use, and shows sample output plots. DOE

N87-19011# Los Alamos National Lab., N. Mex.
IMPLEMENTATION AND OPTIMIZATION OF PORTABLE STANDARD LISP FOR THE CRAY
J. W. Anderson, R. R. Kessler, and W. F. Galway 1987 14 p Presented at the 20th Annual Hawaii International Conference on System Sciences, Honolulu, Hawaii, 6 Jan. 1987 Prepared in cooperation with Utah Univ., Salt Lake City
(Contract W-7405-eng-36)
(DE86-013818; LA-UR-86-2662; CONF-870108-1) Avail: NTIS HC A02/MF A01

Portable Standard LISP (PSL), a dialect of LISP developed at the University of Utah, has been implemented on the CRAY-1s and CRAY X-MPs at the Los Alamos National Laboratory and at the National Magnetic Fusion Energy Computer Center at Lawrence Livermore National Laboratory. This implementation was developed using a highly portable model and then tuned for the Cray architecture. The speed of the resulting system is quite impressive, and the environment is very good for symbolic processing. DOE

N87-19012# Institut National Polytechnique, Grenoble (France). Lab. d'Automatique de Grenoble.
AN IDENTIFICATION PROGRAM FOR AUTOMATIC COMPUTER AIDED DESIGN Ph.D. Thesis [CONCEPTION ASSISTEE PAR ORDINATEUR EN AUTOMATIQUE. UN LOGICIEL D'IDENTIFICATION]
Pierre Laporte 1985 185 p In FRENCH
(ETN-87-99027) Avail: NTIS HC A09/MF A01

The computer programs developed for computer aided control systems design are reviewed, discussing the methods used for the different stages of the design, including simulation, modeling, identification, and regulator synthesis. A selection of the best identification methods was used to implement a computer program, which is discussed and described. The trends of development of this type of computer aided design are also discussed, particularly the impact of artificial intelligence techniques. ESA

N87-19013# Fabrique Nationale d'Armes de Guerre, Herstal-les-Liege (Belgium).
PROGRAM FOR DESIGNING FLAT CAMS ON EUCLID [LOGICIEL DE REALISATION DE CAMES PLANES SOUS EUCLID]
F. vanSteenacker 29 Nov. 1985 56 p Partly in FRENCH and ENGLISH
(ETN-87-99161) Avail: NTIS HC A04/MF A01

The basic equations and a listing of a program to design flat cams are presented. ESA

N87-19014# FOM-Inst. voor Plasmafysica, Rijnhuizen, Jutphaas (Netherlands).
SYSTEMATIC CONTROL OF LARGE COMPUTER PROGRAMS CCL, UPDATE, AND FORTRAN PROCEDURES
J. P. Goedbloed and L. Klieb Jul. 1986 102 p Sponsored by Euratom, and Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek
(Rept-86-169; ETN-87-99214) Avail: NTIS HC A06/MF A01

A package of CCL, UPDATE, and FORTRAN procedures which facilitates the systematic control and development of large scientific computer programs is described. The package provides a general tool box which contains many conveniences for the systematic administration of files, editing, reformatting of line printer output files, etc. Procedures for structured development of a large computer program which is used by a group of scientists are included. The essence of the method is contained in three procedures for the creation of a new UPDATE program library, its revision, and execution, and a procedure REVISE which provides a joint editor-UPDATE session which combines the advantages of the two systems, i.e., speed and rigor. ESA

N87-19015# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Informatics.
COMBINATORGRAPH REDUCTION AND THE CHURCH-ROSSER PROPERTY
P. M. vandenBroek and G. F. vanderHoeven Jun. 1986 18 p
(INF-86-15; ETN-87-99230) Avail: NTIS HC A02/MF A01

A rigorous treatment of combinatorgraph reduction is given by means of the theory of graph rewrite systems. A set of constraints on sets of rewrite rules for combinatorgraphs is established such that under these constraints direct rewritings of combinatorgraphs are parallel independent. This implies that combinatorgraph reduction has the strong Church-Rosser property. ESA

N87-19016# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Informatics.
DETERMINISTIC PARSING OF ATTRIBUTE GRAMMARS. PART 1: TOP-DOWN ORIENTED STRATEGIES
Rieks opdenAkker Jun. 1986 47 p
(INF-86-19-Pt-1; ETN-87-99233) Avail: NTIS HC A03/MF A01

Characteristic parsing strategies for context-free grammars were evaluated in order to see whether it is possible to evaluate all the attributes during parsing. Top-down oriented parsing strategies and the related classes of attribute grammars for which these strategies are suitable were considered. Three classes of one-pass attributed grammars are defined: attributed LL(k), attributed left part, and attributed strong deterministic grammars. Work on the parsing of attribute grammars and attribute-directed parsing is reviewed. ESA

N87-19017# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
MATRIX SUBx IN COMPUTER AIDED CONTROL SYSTEM DESIGN
A. P. Terpstra 20 Dec. 1985 16 p Submitted for publication
(NLR-MP-86002-U; ETN-87-99301) Avail: NTIS HC A02/MF A01

Aerospace user experience with the computer aided control systems design package MATRIXx is discussed. Its capabilities are amply sufficient to satisfy at least the general control system design and analysis needs of a Space Division. The package is expensive, but offers many features important for extensive use in research and development environments in industry, such as reliability, ease of use, and support. No comparable package was available at the time of the evaluation (Spring 1985). ESA

N87-19018# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
A PERSPECTIVE OF MATHEMATICAL SIMULATION AND OPTIMIZATION TECHNIQUES IN COMPUTER AIDED DESIGN
R. F. vandenDam 18 Dec. 1985 26 p Presented at the Second International Conference on Computer Applications in Production and Engineering, Copenhagen, Denmark, 20-23 May 1986
(NLR-MP-85088-U; B8677588; ETN-87-99510) Avail: NTIS HC A03/MF A01

The use of mathematical simulation and optimization techniques by designers is discussed. The principles underlying these techniques are outlined. Aerospace applications are presented to illustrate their usefulness in design processes and the integration of these design methods into structured systems for computer aided design is considered. ESA

N87-19019# National Bureau of Standards, Gaithersburg, Md. Inst. for Computer Sciences and Technology.
EXPERIMENT IN SOFTWARE ACCEPTANCE TESTING
D. R. Wallace Jul. 1986 20 p
(PB86-247590; NBSIR-86-3407) Avail: NTIS HC A02/MF A01 CSCL 09B

Software acceptance testing was performed on a prototype software engineering environment as part of the program to provide information to Federal agencies for improving quality and productivity in software development and maintenance. The purpose of software acceptance testing is to demonstrate to its purchasers that the software satisfies its requirements. The report describes the method and standards applied in this study in software acceptance testing. The report also discusses the difficulties encountered during the study and proposes research directions for software acceptance testing. GRA

N87-19020# National Bureau of Standards, Gaithersburg, Md. Inst. for Computer Sciences and Technology.
STUDY OF A PROTOTYPE SOFTWARE ENGINEERING ENVIRONMENT
D. R. Wallace and D. R. Kuhn Jun. 1986 24 p
(PB86-245263; NBSIR-86-3408) Avail: NTIS HC A02/MF A01 CSCL 09B

A prototype sofeware engineering environment was studied as part of the program to provide information to Federal agencies on software tools for improving quality and productivity in software development and maintenance. The purpose of a software engineering environment is to surround its users with software tools necessary for systematic development and maintenance of software. The report presents the results of the study of the prototype software engineering environment with respect to its features. The report also presents several factors to consider when evaluating a software engineering environment. GRA

N87-18857*# George Washington Univ., Washington, D.C. Dept. of Operations Research.
COMPUTABLE OPTIMAL VALUE BOUNDS FOR GENERALIZED CONVEX PROGRAMS
Anthony V. Fiacco and Jerzy Kyparisis (Florida International Univ., Miami) *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 11-18 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N87-19021*# National Aeronautics and Space Administration. Pasadena Office, Calif.
LOCAL AREA NETWORK WITH FAULT-CHECKING, PRIORITIES AND REDUNDANT BACKUP Patent Application
Sergio Morales, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena) and Gary L. Friedman, inventor (to NASA) Filed 8 Sep. 1986 26 p
(Contract NAS7-918)
(NASA-Case-NPO-16949-1-CU; NAS 1.71:NPO-16949-1-CU; US-Patent-Appl-SN-927987) Avail: NTIS HC A03/MF A01 CSCL 09B

This invention is a redundant error detecting and correcting local area networked computer system having a plurality of nodes each including a network connector board within the node for

connecting to an interfacing transceiver operably attached to a network cable. There is a first network cable disposed along a path to interconnect the nodes. The first network cable includes a plurality of first interfacing transceivers attached thereto. A second network cable is disposed in parallel with the first cable and, in like manner, includes a plurality of second interfacing transceivers attached thereto. There are a plurality of three position switches each having a signal input, three outputs for individual selective connection to the input, and a control input for receiving signals designating which of the outputs is to be connected to the signal input. Each of the switches includes means for designating a response address for responding to addressed signals appearing at the control input and each of the switches further has its signal input connected to a respective one of the input/output lines from the nodes. Also, one of the three outputs is connected to a respective one of the plurality of first interfacing transceivers. There is master switch control means having an output connected to the control inputs of the plurality of three position switches and an input for receiving directive signals for outputting addressed switch position signals to the three position switches as well as monitor and control computer means having a pair of network connector boards therein connected to respective ones of one of the first interfacing transceivers and one of the second interfacing transceivers and an output connected to the input of the master switch means for monitoring the status of the networked computer system by sending messages to the nodes and receiving and verifying messages therefrom and for sending control signals to the master switch to cause the master switch to cause respective ones of the nodes to use a desired one of the first and second cables for transmitting and receiving messages and for disconnecting desired ones of the nodes from both cables.
NASA

N87-19022*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DISTRIBUTED COMPUTER SYSTEM ENHANCES PRODUCTIVITY FOR SRB JOINT OPTIMIZATION
James L. Rogers, Jr., Katherine C. Young, and Jean-Francois M. Barthelemy Feb. 1987 7 p Presented at the 28th AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, Monterey, Calif., 6-8 Apr. 1987
(NASA-TM-89108; NAS 1.15:89108) Avail: NTIS HC A02/MF A01 CSCL 09B

Initial calculations of a redesign of the solid rocket booster joint that failed during the shuttle tragedy showed that the design had a weight penalty associated with it. Optimization techniques were to be applied to determine if there was any way to reduce the weight while keeping the joint opening closed and limiting the stresses. To allow engineers to examine as many alternatives as possible, a system was developed consisting of existing software that coupled structural analysis with optimization which would execute on a network of computer workstations. To increase turnaround, this system took advantage of the parallelism offered by the finite difference technique of computing gradients to allow several workstations to contribute to the solution of the problem simultaneously. The resulting system reduced the amount of time to complete one optimization cycle from two hours to one-half hour with a potential of reducing it to 15 minutes. The current distributed system, which contains numerous extensions, requires one hour turnaround per optimization cycle. This would take four hours for the sequential system. Author

N87-19023# State Univ. of New York, Stony Brook.
THE DESIGN AND IMPLEMENTATION OF A NETWORK COMPUTER Final Summary Report, 15 Jun. 1981 - 14 Dec. 1985
Arthur J. Bernstein 29 May 1986 9 p
(Grant AF-AFOSR-0197-81)
(AD-A174600; AFOSR-86-0783TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

The research performed under this grant is concerned with distributed languages and algorithms. The results obtained can be divided into 5 major areas: distributed languages - high level consideration; distributed algorithms; network communication; support of multicast; and computer program verification. GRA

N87-19024# BDM Corp., Albuquerque, N. Mex.
LARGE SCALE COMPUTER NETWORK MODELING
L. D. Chapman, R. A. Lamont, L. K. Kitterman, and W. H. Vandevender 26 Sep. 1986 4 p Presented at the Society for Computer Simulation Southwest Fall Conference, Austin, Tex., 26 Sep. 1986 Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE87-000452; SAND-86-2188; CONF-8609168-1) Avail: NTIS HC A02/MF A01

This effort involves the development of global and detailed network models of a large central computer network system. The models will be utilized in the capacity planning and expansion requirements as future computers are added to the network. A top-down modeling approach is being utilized in creating a global model of the system, followed by a more detailed model as deemed necessary. The global model includes the major network components and through sensitivity analysis will serve to identify areas of criticality. Three areas of criticality will be the basis for the development of the more detailed models. DOE

N87-19025# Institut National Polytechnique, Grenoble (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
SYSTOLIC IMPLEMENTATION OF ADAPTIVE SYSTEMS
P. Comon, Y. Robert, and D. Trystram 8 Sep. 1986 24 p In FRENCH; ENGLISH summary
(CEPHAG-49/86; ETN-87-99043) Avail: NTIS HC A02/MF A01

Systolic computation of projection operators entering digital signal processing, or more generally adaptive systems is discussed. It is shown how such computations arise when dealing with adaptive signal processing. Systolic arrays achieving real time computations are reviewed. ESA

N87-19026# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Informatics.
A FORMAL DESCRIPTION OF FLOW CONTROL BY LATENCY IN LOTOS
Marten vanSinderen Jun. 1986 38 p
(INF-86-12; ETN-87-99228) Avail: NTIS HC A03/MF A01

A data flow control mechanism for connectionless services, with high throughput, short delays, and moderate reliability was developed. The mechanism, called flow control by latency, is suited to high bandwidth networks and more efficient internetworking protocols. It is shown that flow control by latency allows optimization of particular user needs by appropriate parameterization; and is moderately simple in terms of number of protocol data unit types and implied processing overhead. It is shown that the formal description technique LOTOS is a suitable language to describe a low level protocol like this in an unambiguous way, while leaving freedom to the implementor where intended. It facilitates the analysis of a protocol, is helpful in disclosing errors at an early stage, and thus contributes to an architecturally sound design. ESA

N87-19027# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Informatics.
TWENTE UNIVERSITY MULTIPROCESSOR (TUMULT)-VME INTERFACE BOARD, HARDWARE DESCRIPTION
Gerard J. M. Smit and Paul Havinga Jun. 1986 64 p
(INF-86-14; ETN-87-99229) Avail: NTIS HC A04/MF A01

A multiprocessor network is described. The network has a ring topology and interconnects up to 15 processing elements. All processing elements are autonomous which means that each element has its own private memory and a copy of a local operating system. The elements are built up from VME compatible modules. ESA

N87-19028# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Informatics.
CONFORMANCE TESTING OF OPEN SYSTEMS INTERCONNEC-

TION (OSI) SYSTEMS M.S. Thesis
Chris Steenbergen Aug. 1986 129 p Sponsored by the European Economic Commission ESPRIT/SEDOS project
(INF-86-24; ETN-87-99238) Avail: NTIS HC A07/MF A01

Open systems interconnection conformance testing using the LOTOS specification language was studied. It is shown that LOTOS descriptions are implementation independent; LOTOS is well defined, which allows test cases for the different test methods to be derived from other test method test cases and which make it a suitable basis for tools; and that since it is one of the formal description techniques used within ISO, this, together with the well definedness, allows the derivation of tests from formal descriptions. Problems with test generation and the derivation of tests for the distributed test method remain. ESA

N87-19029# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
THE CAD ENVIRONMENT OF THE NATIONAL AEROSPACE LABORATORY NLR, THE NETHERLANDS
W. Loeve, F. J. Heerema, and J. J. P. vanHulzen 23 Jan. 1986 21 p Presented at the Second International Conference on Computer Applications in Production and Engineering, Copenhagen, Denmark, 20-23 May 1986
(NLR-MP-86005-U; B8677587; ETN-87-99512) Avail: NTIS HC A02/MF A01

A computer aided design infrastructure for aerospace applications is described. The main components of the infrastructure are facilities for data management, method management, and user interfaces, all implemented on a computer and terminal network. The facilities for data management and user interfaces gained widespread acceptance by application system developers and end users. The facilities for method management are in initial state of development and are supported by a wide range of applications. The computer and terminal network gives access to data and methods from virtually any location at two sites. ESA

N87-19030# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
PSEUDO-CONSERVATION LAWS IN CYCLIC-SERVICE SYSTEMS
O. J. Boxma and W. P. Groenendijk Jun. 1986 15 p Submitted for publication
(CWI-OS-R8606; B8674414; ETN-87-99518) Avail: NTIS HC A02/MF A01

Single-server, multiqueue systems with cyclic service are considered. Non-zero switchover times of the server between consecutive queues are assumed. A stochastic decomposition for the amount of work in such systems is obtained. The decomposition allows a short derivation of a pseudo-conservation law for a weighted sum of the mean waiting times at the various queues. Conservation laws are generalized and explained. ESA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N87-19031# Army Concepts Analysis Agency, Bethesda, Md.
AAAI (AMERICAN ASSOCIATION ON ARTIFICIAL INTELLIGENCE) WORKSHOP ON AI (ARTIFICIAL INTELLIGENCE) SIMULATION
Arthur Gerstenfeld, Richard Modjeski, Y. V. Reddy, and Marilyn Stelzner Aug. 1986 177 p Workshop held in Philadelphia, Pa., 11 August 1986
(AD-A174053) Avail: NTIS HC A09/MF A01 CSCL 09/2

The First Artificial Intelligence (AI) and simulation workshop was held during the National Conference on Artificial Intelligence on August 11, 1986 at the University of Pennsylvania (Wharton Hall). Topics addressed included: air traffic control; knowledge engineering; symbolic explanation systems; model validation; cognition constraints; command, control, and communication systems; electronic troubleshooting; robotics; automatic programming system; petri nets; and parallel processing. B.G.

N87-19032# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
ACHIEVING ARTIFICIAL INTELLIGENCE THROUGH BUILDING ROBOTS
Rodney A. Brooks May 1986 13 p
(Contract N00014-85-K-0124)
(AD-A174364; AI-M-899) Avail: NTIS HC A02/MF A01 CSCL 06/4

We argue that generally accepted methodologies of Artificial Intelligence research are limited in the proportion of human level intelligence they can be expected to emulate. We argue that the currently accepted decomposition and static representations used in such research are wrong. We argue for a shift to a process based model, with a decomposition based on task achieving behaviors as the organizational principle. In particular we advocate building robotic insects. GRA

N87-19033# Oak Ridge National Lab., Tenn.
UNCERTAINTY PARADIGMS USED IN EXPERT SYSTEMS
R. Uppuluri and B. Tonn 1986 9 p Presented at the International Symposium on Methodologies for Intelligent Systems, Knoxville, Tenn., 22 Oct. 1986
(Contract DE-AC05-84OR-21400)
(DE86-012229; CONF-861096-1) Avail: NTIS HC A02/MF A01

This paper reviews four uncertainty paradigms used in expert systems, the Bayesian approach, certainty factors, Dempster-Shafer theory, and the theory of endorsements. The first three paradigms operate with quantitative measures of uncertainty; the last uses only qualitative expressions. Each paradigm is briefly discussed and strengths and weaknesses are noted. It is found that the mathematical rigor of the quantitative approaches may compromise their applicability in expert systems and that the qualitative approach lacks sufficient rigor. DOE

N87-19034# Lawrence Livermore National Lab., Calif.
COOPERATING INTELLIGENT AGENTS Ph.D. Thesis
C. Mason Dec. 1986 44 p
(Contract W-7405-eng-48)
(DE87-003976; UCID-20928) Avail: NTIS HC A03/MF A01

Distributed Artificial Intelligence is the subfield of Artificial Intelligence concerned with the creation of intelligent problem solving systems which are based on observations of cooperative systems in our lives. This group problem solving approach promises a number of advantages over current sequentially based problem solvers. This paper presents an overview of the research issues which concern Distributed Artificial Intelligence and focuses on the design of such systems. DOE

N87-19035# Institut National Polytechnique, Grenoble (France). Lab. d'Automatique de Grenoble.
SOME THEORETICAL AND EXPERIMENTAL RESULTS ON ADAPTIVE CONTROL: A SIMPLE CONTINUOUS ADAPTIVE CONTROL; AN ADAPTIVE PID BASED ON THE POSITION OF POLES Ph.D. Thesis [QUELQUES RESULTATS THEORIQUES ET PRATIQUES SUR LA COMMANDE ADAPTATIVE: UNE COMMANDE ADAPTATIVE CONTINUE SIMPLE; UN PID ADAPTATIF BASE SUR LE PLACEMENT DE POLES]
Rafael Kelly 1986 49 p In FRENCH
(ETN-87-99026) Avail: NTIS HC A03/MF A01

Control theory and command implementation are studied with particular reference to robustness analysis. A simple adaptive continuous command is described. A single adaptive parameter is involved, leading to a time-invariant model. Application to a heat transfer device is discussed. A bibliographic survey of proportional integrating differentiating controllers designed by the pole location method is also presented. ESA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N87-19036*# National Aeronautics and Space Administration, Washington, D.C.
THE ALGEBRAIC CRITERIA FOR THE STABILITY OF CONTROL SYSTEMS
H. Cremer and F. H. Effertz Sep. 1986 36 p Transl. into ENGLISH from Mathematische Annalen (West Germany), no. 137, 1959 p 328-350 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88517; NAS 1.15:88517) Avail: NTIS HC A03/MF A01 CSCL 12A

This paper critically examines the standard algebraic criteria for the stability of linear control systems and their proofs, reveals important previously unnoticed connections, and presents new representations. Algebraic stability criteria have also acquired significance for stability studies of non-linear differential equation systems by the Krylov-Bogoljubov-Magnus Method, and allow realization conditions to be determined for classes of broken rational functions as frequency characteristics of electrical network. Author

N87-19037# Queensland Univ., St. Lucia (Australia). Dept. of Civil Engineering.
SORE-PLUS: AN OUT OF CORE SKYLINE SOLUTION ROUTINE
J. L. Meek and B. Bandyopadhyay Jun. 1985 55 p
(CE-59) Avail: NTIS HC A04/MF A01

The solution of large systems of equations with mixed variables is discussed. That is, in the stiffness method of structural analysis, both nodal displacements and forces are unknown. From this it is also able to perform static condensation of a stiffness matrix without reordering the node-numbers of the system of equations, and thus the skyline profile is perserved. The utility routines associated with the formation of the stiffness matrix as well as the solution algorithm itself are given in the appendix. Author

N87-19038*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RKH SPACE APPROXIMATIONS FOR THE FEEDBACK OPERATOR IN A LINEAR HEREDITARY CONTROL SYSTEM Final Report
J. A. Reneke and R. E. Fennell (Clemson Univ., S.C.) Feb. 1987 24 p Submitted for publication
(Contracts NAS1-18107; N00014-86-K-0693; Grant AF-AFOSR-02336-84)
(NASA-CR-178240; ICASE-87-8; NAS 1.26:178240) Avail: NTIS HC A02/MF A01 CSCL 12A

Computational implementation of feedback control laws for linear hereditary systems requires the approximation of infinite dimensional feedback operators with finite dimensional operators. The dense subspaces of K-polygonal functions in reproducing kernel Hilbert spaces, RKH spaces, suggest finite dimensional approximations of the matrix representations of the control operators. A convergence theorem is developed for the approximations and the numerical implementation of the approximations is discussed. Author

N87-19039*# Texas A&M Univ., College Station. Dept. of Electrical Engineering.
ON THE SYNCHRONIZABILITY AND DETECTABILITY OF RANDOM PPM SEQUENCES
Costas N. Georghiades and Shu Lin 25 Mar. 1987 32 p
(Grant NAG5-778)
(NASA-CR-180190; NAS 1.26:180190; TR-3) Avail: NTIS HC A03/MF A01 CSCL 12A

The problem of synchronization and detection of random pulse-position-modulation (PPM) sequences is investigated under the assumption of perfect slot synchronization. Maximum-likelihood PPM symbol synchronization and receiver algorithms are derived that make decisions based both on soft as well as hard data; these algorithms are seen to be easily implementable. Bounds derived on the symbol error probability as well as the probability of false synchronization indicate the existence of a rather severe performance floor, which can easily be the limiting factor in the overall system performance. The performance floor is inherent in the PPM format and random data and becomes more serious as the PPM alphabet size Q is increased. A way to eliminate the performance floor is suggested by inserting special PPM symbols in the random data stream. Author

N87-19040# Wisconsin Univ., Madison. Dept. of Computer Sciences.
NUMERICAL ANALYSIS Final Report, 15 Jun. 1982 - 14 Jun. 1986
Seymour V. Parter 14 Jun. 1986 10 p
(Grant AF-AFOSR-0275-82)
(AD-A174936; AFOSR-86-2080TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

New development in computer architecture (parallel computers and multi-processors) and a renewed interest in 3-dimensional problems and higher-order problems have revived interest in iterative methods for elliptic and parabolic finite-difference/finite-element equations. This document considers the linear system Ax = y which arises from the discretization of an elliptic boundary-value problem. A direct (linear stationary) iterative method arises from the splitting A = M - N and takes the form Mx to the k + 1 power = Nx to the k power + y. GRA

N87-19041# Arizona State Univ., Tempe.
SYSTEM IDENTIFICATION METHODS USING AN ALGEBRAIC APPROACH
J. A. Cadzow, S. C. Chen, and O. M. Solomon (Sandia National Labs., Albuquerque, N. Mex.) 1986 5 p Presented at the 3rd IEEE Acoustics, Speech, and Signal Processing Society Workshop on Spectrum Estimation and Modeling, Boston, Mass., 17 Nov. 1986
(Contract DE-AC04-76DP-00789)
(DE87-001416; SAND-86-2415C; CONF-861184-1) Avail: NTIS HC A02/MF A01

In a standard approach to system identification, a pair of signals is observed over a finite time interval and it is desired to determine whether there exists a meaningful linear relationship between them. If a linear relationship is deemed to exist, it is then desired to assign values to the parameters of a linear parametric model so that a high degree of compatibility with the observed signal pair is achieved. This linear parametric model is chosen by the investigator and usually reflects the dynamics believed to characterize the underlying process being studied. In this paper, the standard least squares method and two algebraically structured methods recently developed by the authors are examined and their comparative performances empirically tested. It is found that the procedure designated as the near null space method outperforms both the classical least squares method and the correlation coefficient method. DOE

N87-19042# Oak Ridge National Lab., Tenn.
PROGRAM FOR SOLVING THE 3-DIMENSIONAL LAPLACE EQUATION VIA THE BOUNDARY ELEMENT METHOD
L. J. Gray Sep. 1986 32 p
(Contract DE-AC05-84OR-21400)
(DE87-001612; ORNL/TM-9816) Avail: NTIS HC A03/MF A01

A subroutine for solving the interior three dimensional LaPlace equation del(2) V - 0 by the boundary element method is described. The bounding surface is defined by triangular elements, each element defined by three nodes (vertices) in appropriate order for calculating the outward normal. The boundary data at a boundary node P is either the value of the potential V(P) or the normal derivative of V(P). The required integrals over the triangular elements are computed using linear interpolation from the nodal values. This routine has been especially tailored in several ways for use in modeling electrochemical processes. DOE

N87-19043# Mound Lab., Miamisburg, Ohio.
EXTENSIONS OF THE OPERATIONAL METHOD
G. L. Silver 25 Aug. 1986 30 p
(Contract DE-AC04-76DP-00053)
(DE87-001839; MLM-3382) Avail: NTIS HC A03/MF A01

The operational method of data analysis is used to develop new formulas for first and second derivatives on equidistant, curvilinear data consisting of three or more measurements. Echo functions are used to suggest the paths followed by moving data points, and a method of interpolating into rectangles by non-Euclidean geometry is proposed. DOE

N87-19044# Sandia National Labs., Albuquerque, N. Mex. Applied Mathematics Dept.
OBJECT LOCATION USING COMBINED TIME-OF-ARRIVAL, LINE-OF-SIGHT AND DISTANCE MEASUREMENTS
E. A. Aronson Aug. 1986 18 p
(Contract DE-AC04-76DP-00789)
(DE86-015119; SAND-86-0842) Avail: NTIS HC A02/MF A01

A method is described for estimating the location of an object using combined time-of-arrival, line-of-sight, and certain distance measurements. Methods are also given for estimating the statistics of the errors in the location due to errors in the data. DOE

N87-19045# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
ON REGULAR MINIMAX OPTIMIZATION
H. Th. Jongen and G. Zwier Sep. 1986 48 p
(MEMO-590; ISSN-0169-2690; ETN-87-99069) Avail: NTIS HC A03/MF A01

Functions of maximum type subject to (in)equality constraints are considered. The space dimension is finite, and the maximum is taken over a compact manifold with boundary. Local minimization algorithms based on Newton's method can be derived if a local minimum is nondegenerate (in a two-level sense). Nondegeneracy refers to a local (implicit) reduction of the original max-function to another one, where the maximum is taken over a finite set, and refers to strict complementarity and nondegeneracy of the underlying quadratic form with respect to the reduced stationary situation. It is shown that the set of n-parameter families of functions for which the stationary points of corresponding max-function are nondegenerate constitutes an open and dense subset in the space of all n-parameter families (the used topology takes derivatives up to second order into account). An application to approximation problems of Chebyshev type is presented. ESA

N87-19046# Politecnico di Milano (Italy). Dipt. di Electtronica.
RESIDUE ARITHMETIC FOR FAULT-TOLERANT MULTIPLIER: THE RESIDUE GENERATOR
V. Piuri and A. Fabi 1986 47 p
(Rept-86-023; ETN-87-99144) Avail: NTIS HC A03/MF A01

Detection and correction of errors due to hardware faults in a VLSI multiplier are treated, with regard to silicon area and time performances. Due to its regularity, modularity, and carry-free properties, Residue Number System (RNS) is considered to design a fault tolerant multiplier, in which the control and correction network avoid intrinsic disadvantages of TMR. Great compactness of additional RNS multipliers is partially masked by the area the binary-residue circuit uses, so careful design of these circuits is required. To achieve a low degradation in performances with respect to the nonfault tolerant multiplier and to contain silicon area, there are two possibilities: choose the best triple of bases for a given number of bits, to be used in the RNS control and correcting network; and choose the suitable binary to residue conversion circuit, considering area and delay. ESA

N87-19047# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
TRANSFORMATIONS OF LINEAR SYSTEMS UNDER EXTERNAL EQUIVALENCE
J. M. Schumacher Apr. 1986 24 p Submitted for publication
(CWI-OS-R8604; B8674412; ETN-87-99516) Avail: NTIS HC A02/MF A01

Systems of linear differential and algebraic equations in which variables are distinguished as external variables are considered. Two systems are called equivalent if the set of solutions for the external variables is the same for both systems. An operational form for this definition of equivalence is given by describing a set of system transformations having the property that two systems are equivalent if and only if they can be taken into each other by transformations from that set. An algorithm to transform a given system in general form to a system in minimal state space form is described. This algorithm first takes the equations to first-order form, so that each subsequent step can be formulated and interpreted in state space terms. Structure indices are computed in terms of a state space description in nonminimal form and used to prove the minimality of the end result of the algorithm. An application to the problem of ill-posedness of feedback connections is shown. ESA

N87-18856*# Princeton Univ., N. J. Dept. of Chemistry.
ON DETERMINING IMPORTANT ASPECTS OF MATHEMATICAL MODELS: APPLICATION TO PROBLEMS IN PHYSICS AND CHEMISTRY
Herschel Rabitz *In* NASA. Langley Research Center Senstivity Analysis in Engineering Feb. 1987 p 1-9 Sponsored in part by ONR (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 12A

N87-18858*# California Univ., Santa Barbara.
ALTERNATIVE METHODS FOR CALCULATING SENSITIVITY OF OPTIMIZED DESIGNS TO PROBLEM PARAMETERS
G. N. Vanderplaats and H. D. Cai (Engineering Design Optimization, Inc., Santa Barbara, Calif.) *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 19-32 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 12A

N87-18867*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
SURVEY OF METHODS FOR CALCULATING SENSITIVITY OF GENERAL EIGENPROBLEMS
Durbha V. Murthy and Raphael T. Haftka *In* NASA. Langley Research Center Sensitivity Analysis in Engineering Feb. 1987 p 177-196 (For primary document see N87-18855 11-39)
Avail: NTIS HC A16/MF A01 CSCL 12A

N87-19083# Nihon Univ., Tokyo (Japan). Dept. of Physics.
LONG-TIME CORRELATION IN THE TWO-WAVE HAMILTONIAN
H. Irie and T. Hatori (Nagoya Univ., Japan) *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 52-61 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

N87-19084# Waseda Univ., Tokyo (Japan). Dept. of Applied Physics.
THE f-GAMMA SPECTRUM AND STAGNANT MOTIONS IN PHASE SPACE
Yoji Aizawa *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 62-70 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N87-19048# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A STOCHASTIC APPROACH TO GENERATE A PROJECTION

OF THE GRADIENT TYPE METHOD
Atair Rios Neto and Ricardo L. U. F. Pinto Nov. 1986 18 p Submitted for publication
(INPE-4060-PRE/1019) Avail: NTIS HC A02/MF A01

A stochastic approach is proposed to generate a direct search procedure where errors in the constraints are inherently treated. The objective is to have the possibility of directly considering the relative accuracy in the satisfaction of constraints, when one is numerically solving a nonlinear constrained optimization problem. This is done by adding to the numerical algorithm the feature of modelling as random variables the errors with which the constraints are supposed to be approximated. Use is made of linear estimation theory, reducing the search increment determination to a problem of parameter estimation with a priori information. This problem is solved with the Gauss-Markov estimator in the Kalman form. The first order, direct search method, shows that results can be viewed as a stochastic version of the projection of the gradient method. An analysis is made showing the relationships between the proposed stochastic version and the existing deterministic method. Author

N87-19049# Los Alamos National Lab., N. Mex.
DISTRIBUTION SELECTION IN STATISTICAL SIMULATION STUDIES
M. E. Johnson 1986 15 p Presented at the Winter Simulation Conference, Washington, D.C., 8 Dec. 1986
(Contract W-7405-eng-36)
(DE86-013826; LA-UR-86-2584; CONF-861218-1) Avail: NTIS HC A02/MF A01

The statistics profession has been remiss in exploiting the numerous advances in simulation methodology. The purpose of this article is to outline progress in variate generation relevant to the conduct of statistical simulation studies. The emphasis is on multivariate distributions, a thriving area of research. DOE

N87-19050# Amsterdam Univ. (Netherlands). Faculty of Actuarial Science and Econometrics.
CONSISTENT MAXIMUM LIKELIHOOD ESTIMATION WITH DEPENDENT OBSERVATIONS: THE GENERAL (NON-NORMAL) CASE AND THE NORMAL CASE
R. D. H. Heijmans and J. R. Magnus 1985 58 p Revised Sponsored by the Netherlands Organization for the Advancement of Pure Research
(AE-24/85-Rev; B8660518; ETN-87-99151) Avail: NTIS HC A04/MF A01

Conditions for the existence and weak consistency of the maximum likelihood estimator in a multiparameter framework, assuming neither the independance nor the identical distribution of the observations, are established. It is assumed that the joint density of the observations is known (except for the values of a finite number of parameters to be estimated), without specifying this distribution. In a second condition, the distribution is specified, assuming joint normality (but not independence) of the observations. ESA

N87-19051# Institut National Polytechnique, Grenoble (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
CONTRIBUTION TO THE STUDY OF HYPOTHESIS TESTS CONCERNING THE COVARIANCE OPERATOR OF A GAUSSIAN PROCESS Ph.D. Thesis [CONTRIBUTION A L'ETUDE DES TESTS D'HYPOTHESES CONCERNANT L'OPERATEUR COVARIANCE D'UN PROCESSUS GAUSSIEN]
Georges Tziritas 1985 256 p In FRENCH
(ETN-87-99024) Avail: NTIS HC A12/MF A01

Complex random vectors and the particular case of circular complex random vectors in the space product of two Hilbert spaces are studied in order to model random transmission channels. The definitions of random linear operators in Hilbert spaces are reviewed. The estimation of order two generalized moments of the Gaussian probability measure are discussed. It is proved that the exhaustive statistics to solve the discussed problem is a quadratic function of the observed vector. The implied probability distribution of a Gaussian vector quadratic function in a Hilbert space is studied and a method to develop the probability distribution by a positive definite Laguerre polynomials series is presented. Practical applications to random transmission channels are described. ESA

N87-19052# Instituut TNO voor Wiskunde, Informatieverwerking en Statistiek, The Hague (Netherlands). Wageningen Section.
SUCCESSIVE MEASUREMENT EXPERIMENTS: ANALYSIS AND INTERPRETATION
Bertus Keen, Jac Thissen, Janneke Hoekstra, and Hans Jansen 1 Jul. 1986 28 p Revised
(Grant IWIS-TNO-07.6.A7817)
(IWIS-A-85-ST-35; IWIS-A-84-ST-25; B8565747; ETN-87-99213) Avail: NTIS HC A03/MF A01

Application of common techniques such as regression analysis and analysis of variance to successive measurement experiments is introduced. Analysis for a compound symmetry structure; for an individual curve model with independent errors; and for the general multivariate covariance structure is covered. Uncontrolled conditions are discussed. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

No abstracts in this category.

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N87-19053# Loughborough Univ. of Technology (England). Dept. of Mathematics.
ONE DEGREE OF FREEDOM FOR NON-ADDITIVITY: APPLICATIONS WITH GENERALIZED LINEAR MODELS AND LINK FUNCTIONS
A. N. Pettitt Nov. 1986 29 p
(LUT-MR-195) Avail: NTIS HC A03/MF A01

The unreplicated two-way table of observations is considered with generalized linear models being fitted. The predictor, which is linear in row and column effects, is extended to include an interaction term which is multiplicative in the row and column effects and equivalent to one degree of freedom for nonadditivity term of Tukey (1949). Various interpretations of the model are given, including the suggestion of a new link function. An example involving the 3 x 4 table of survival times is analyzed. Extensions are considered. Author

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N87-19054# Brookhaven National Lab., Upton, N. Y.
SUPERCONDUCTING MAGNETS AND CRYOGENICS: PROCEEDINGS
P. F. Dahl 1986 338 p Presented at the International Committee for Future Accelerators Workshop on Superconducting Magnets and Cryogenics, Upton, N.Y., 12 May 1986
(Contract DE-AC02-76CH-00016)
(DE87-001456; BNL-52006; CONF-860583) Avail: NTIS HC A15/MF A01

Separate abstracts were prepared for 70 papers in these

workshop proceedings. Topics covered include: superconducting accelerator magnet research and development; superconductor development; electrical measurements; magnet design and construction methods; field correction methods; power schemes and quench protection; cryogenic systems; and magnet measurements. DOE

N87-19055*# National Academy of Sciences - National Research Council, Washington, D. C.
PHYSICS THROUGH THE 1990s: AN OVERVIEW
1986 206 p Sponsored by NASA, DOD, DOE and NSF
(NASA-CR-180050; NAS 1.26:180050; PB86-241536; ISBN-0-309-03578-3; LC-85-30999) Avail: NTIS HC A10/MF A01 CSCL 05A

The volume details the interaction of physics and society, and presents a short summary of the progress in the major fields of physics and a summary of the other seven volumes of the Physics through the 1990s series, issues and recommended policy changes are described regarding funding, education, industry participation, small-group university research and large facility programs, government agency programs, and computer database needs. Three supplements report in detail on international issues in physics (the US position in the field, international cooperation and competition-especially on large projects, freedom for scientists, free flow of information, and education of foreign students), the education and supply of physicists (the changes in US physics education, employment and manpower, and demographics of the field), and the organization and support of physics (government, university, and industry research; facilities; national laboratories; and decision making). An executive summary contains recommendations for maintaining excellence in physics. A glossary of scientific terms is appended. GRA

N87-19056*# National Academy of Sciences - National Research Council, Washington, D. C.
PHYSICS THROUGH THE 1990s: SCIENTIFIC INTERFACES AND TECHNOLOGICAL APPLICATIONS
1986 286 p Sponsored by NASA, DOD, DOE and NSF
(NASA-CR-180049; NAS 1.26:180049; PB86-241510; ISBN-0-309-03580-5; LC-85-32039) Avail: NTIS HC A13/MF A01 CSCL 05A

The volume examines the scientific interfaces and technological applications of physics. Twelve areas are dealt with: biological physics-biophysics, the brain, and theoretical biology; the physics-chemistry interface-instrumentation, surfaces, neutron and synchrotron radiation, polymers, organic electronic materials; materials science; geophysics-tectonics, the atmosphere and oceans, planets, drilling and seismic exploration, and remote sensing; computational physics-complex systems and applications in basic research; mathematics-field theory and chaos; microelectronics-integrated circuits, miniaturization, future trends; optical information technologies-fiber optics and photonics; instrumentation; physics applications to energy needs and the environment; national security-devices, weapons, and arms control; medical physics-radiology, ultrasonics, MNR, and photonics. An executive summary and many chapters contain recommendations regarding funding, education, industry participation, small-group university research and large facility programs, government agency programs, and computer database needs. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environment Pollution.*

N87-19057*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE REDUCTION FOR MODEL COUNTERROTATION PROPELLER AT CRUISE BY REDUCING AFT-PROPELLER DIAMETER
James H. Dittmar and David B. Stang (Sverdrup Technology, Inc., Cleveland, Ohio) 1987 31 p Prepared for presentation at the 113th Meeting of the Acoustical Society of America, Indianapolis, Ind., 11-15 May 1987
(NASA-TM-88936; E-3378; NAS 1.15:88936) Avail: NTIS HC A03/MF A01 CSCL 20A

The forward propeller of a model counterrotation propeller was tested with its original aft propeller and with a reduced diameter aft propeller. Noise reductions with the reduced diameter aft propeller were measured at simulated cruise conditions. Reductions were as large as 7.5 dB for the aft-propeller passing tone and 15 dB in the harmonics at specific angles. The interaction tones, mostly the first, were reduced probably because the reduced-diameter aft-propeller blades no longer interacted with the forward propeller tip vortex. The total noise (sum of primary and interaction noise) at each harmonic was significantly reduced. The chief noise reduction at each harmonic came from reduced aft-propeller-alone noise, with the interaction tones contributing little to the totals at cruise. Total cruise noise reductions were as much as 3 dB at given angles for the blade passing tone and 10 dB for some of the harmonics. These reductions would measurably improve the fuselage interior noise levels and represent a definite cruise noise benefit from using a reduced diameter aft propeller. Author

N87-19058# Mississippi Univ., University. Physical Acoustics Research Lab.
STUDY OF OPTICAL SOUND GENERATION AND AMPLIFICATION Annual Report, 1 Nov. 1985 - 31 Oct. 1986
Henry E. Bass and F. D. Shields 1 Nov. 1986 23 p
(Contract N00014-84-C-0193)
(AD-A174287; PARGUM-86-04) Avail: NTIS HC A02/MF A01 CSCL 20/1

This project involves three separate tasks, i.e.: (1) generation of low frequency sound from optical pulses; (2) propagation of sound through a gas with an overpopulation of vibrationally excited states; and, (3) optoacoustic studies in liquids. The three tasks, funded by the physics division of ONR, represent a three-pronged study of the generation of sound by the absorption of light and amplification of a propagating sound wave. Generation of low frequency sound from a series of optical pulses involves optimizing the density of pulses to obtain maximum energy at low frequencies. The present effort is devoted to numerical simulation. With present modulation schemes, as much as 50% of the energy appears in the desired fundamental, but predicted harmonic distortion is unacceptable. Amplification of sound propagating through gas with an overpopulation of vibrationally excited states has now been observed in N2/H2,N2/He, and N2/CH4 mixtures. The gas is excited with an electrical discharge. Present efforts are devoted to achieving better agreement between theory and experiment. Optoacoustic pulses have been observed in several alcohols and water. The optoacoustic amplitude has been observed as a function of laser energy, distance from excitation zone to detection region, and optical absorption coefficient. Author (GRA)

N87-19059# Institut National Polytechnique, Grenoble (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
MODELS, IDENTIFICATION AND DETECTION SYSTEMS FOR NON-GAUSSIAN NOISE [MODELISATION, IDENTIFICATION ET SYSTEMES DE DETECTION DE BRUITS NON GAUSSIENS]
H. Cherifi 1986 131 p In FRENCH
(Contract N00014-84-C-0212)
(CEPHAG-30/86; ETN-87-99038) Avail: NTIS HC A07/MF A01

Problems found in underwater acoustics where the noise is not Gaussian are discussed. A statistical model to describe the distribution of that noise is defined. The estimators and the detection devices which are derived from the model are discussed. It is shown that the noise statistical properties given by the model are accurate. The errors produced by using a Gaussian model are discussed. ESA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N87-19060*# National Academy of Sciences - National Research Council, Washington, D. C.
PHYSICS THROUGH THE 1990s: NUCLEAR PHYSICS
1986 233 p Sponsored by NASA, DOD, DOE and NSF
(NASA-CR-180054; NAS 1.26:180054; PB86-241494;
ISBN-0-309-03547-3; LC-85-10584) Avail: NTIS HC A11/MF A01 CSCL 20H

The volume begins with a non-mathematical introduction to nuclear physics. A description of the major advances in the field follows, with chapters on nuclear structure and dynamics, fundamental forces in the nucleus, and nuclei under extreme conditions of temperature, density, and spin. Impacts of nuclear physics on astrophysics and the scientific and societal benefits of nuclear physics are then discussed. Another section deals with scientific frontiers, describing research into the realm of the quark-gluon plasma; the changing description of nuclear matter, specifically the use of the quark model; and the implications of the standard model and grand unified theories of elementary-particle physics; and finishes with recommendations and priorities for nuclear physics research facilities, instrumentation, accelerators, theory, education, and data bases. Appended are a list of national accelerator facilities, a list of reviewers, a bibliography, and a glossary. GRA

N87-19061*# National Academy of Sciences - National Research Council, Washington, D. C.
PHYSICS THROUGH THE 1990s: ELEMENTARY-PARTICLE PHYSICS
1986 251 p Sponsored by NASA, DOD, DOE and NSF
(NASA-CR-180053; NAS 1.26:180053; PB86-241460;
ISBN-0-309-03576-7; LC-85-15210) Avail: NTIS HC A12/MF A01 CSCL 20H

The volume begins with a non-mathematical discussion of the motivation behind, and basic ideas of, elementary-particle physics theory and experiment. The progress over the past two decades with the quark model and unification of the electromagnetic and weak interactions is reviewed. Existing theoretical problems in the field, such as the origin of mass and the unification of the fundamental forces, are detailed, along with experimental programs to test the new theories. Accelerators, instrumentation, and detectors are described for both current and future facilities. Interactions with other areas of both theoretical and applied physics are presented. The sociology of the field is examined regarding the education of graduate students, the organization necessary in large-scale experiments, and the decision-making process involved in high-cost experiments. Finally, conclusions and recommendations for maintaining US excellence in theory and experiment are given. Appendices list both current and planned accelerators, and present statistical data on the US elementary-particle physics program. A glossary is included. GRA

N87-19062# Texas Univ., Austin. Inst. for Fusion Studies.
CLASS RENORMALIZATION: ISLANDS AROUND ISLANDS
James D. Meiss *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 28-51 (For primary document see N87-19079 11-75)
(Contract DE-FG05-80ET-53088)
Avail: NTIS HC A16/MF A01

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

N87-19062# Los Alamos National Lab., N. Mex.
GENERAL-PURPOSE HEAT SOURCE DEVELOPMENT: SAFETY VERIFICATION TEST PROGRAM. TITANIUM BULLET/ FRAGMENT TEST SERIES
T. G. George Jun. 1986 30 p
(Contract W-7405-eng-36)
(DE86-013086; LA-10724-MS) Avail: NTIS HC A03/MF A01

The radioisotope thermoelectric generator (RTG) that will provide power for the Galileo and Ulysses space missions contains 18 General-Purpose Heat Source (GPHS) modules. Each module contains four 238PuO2-fueled clads and generates 250 W(t). Because the possibility of launch-pad or postlaunch explosion exists and because any explosion would generate a field of high-energy fragments, the fueled clads within each GPHS module must be able to survive fragment impact. In this test series we investigated the response of bare, simulant-fueled (UO2) clads to the impact of high-energy titanium alloy fragments. We determined that 425m/s is the threshold impact velocity of a 3.25-g titanium bullet that will cause direct mechanical failure of a bare fueled clad. DOE

N87-19063# Lawrence Livermore National Lab., Calif.
HIGH-POWER PULSE PROPAGATION EXPERIMENTS
R. A. Alvarez 2 Dec. 1986 6 p Presented at the General Meeting of the American Physical Society, New York, N.Y., 16 Mar. 1987
(Contract W-7405-eng-48)
(DE87-003441; UCRL-95773; CONF-870308-1) Avail: NTIS HC A02/MF A01

One of the questions that must be answered in assessing the potential of pulsed microwave beams as directed energy weapons is: What is the maximum pulse energy (and/or peak power) that can be delivered from a source to a target. Atmospheric breakdown caused by the electromagnetic fields of the pulse sets one limit on energy propagation, and the breakdown threshold was the subject of fairly extensive investigation a number of years ago. The evolution of microwave source technology has extended the parameter range over which propagation needs to be understood, and additional issues that have not previously been investigated experimentally have assumed a new importance. A new generation of experiments is underway, planned, or proposed to investigate these issues. DOE

74 OPTICS

N87-19064*# National Aeronautics and Space Administration. Pasadena Office, Calif.
REMOTELY CONTROLLABLE REAL-TIME OPTICAL PROCESSOR Patent Application
Hua-Kuang Liu, inventor (to NASA) Filed 7 Nov. 1986 12 p
(Contract NAS7-918)
(NASA-Case-NPO-16750-1-CU; US-Patent-Appl-SN-927972; NAS 1.71:NPO-16750-1-CU) Avail: NTIS HC A02/MF A01 CSCL 20F

An optical processor is provided which facilitates selection of any of a variety of patterns or images which are to be compared with a Fourier transform of a template image, wherein the processor can be constructed at low cost. One of the two images that are to be compared is formed by generating video signals representing the image and using those signals to drive a liquid crystal array through which light passes. NASA

N87-19065*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
OPTIMIZING A CONTINUOUSLY VARIABLE FILTER IN A HYBRID OPTICAL CORRELATOR
Richard D. Juday [1987] 4 p Presented at a conference in Atlanta, Ga., 25-26 Mar. 1987
(NASA-TM-89279; NAS 1.15:89279) Avail: NTIS HC A02/MF A01 CSCL 20F

In contrast to binary filters, continuously variable optical filters offer an ability to compensate for certain imperfections in the optics of a hybrid correlator. Arbitrary static phase errors are introduced into a model of a phase-only filtering hybrid correlator, and a method of discovering a correction for them simulated. By a recursive technique a first approximation to the impulse's matched filter is adjusted (allowed to relax) so as to produce successively more localized distribution of the output in the correlation plane. The method is motivated by the development of continuously-variable phase-only spatial light modulators, but it is applicable to amplitude modulators and -with appropriate modification -- to binary modulators as well. The technique is robust against the form of the system's departure from ideal behavior. Author

N87-19066# Naval Weapons Center, China Lake, Calif.
LIGHT RAYS IN A SPHERICALLY SYMMETRIC MEDIUM Summary Report, Feb. - Mar. 1986
Daniel T. Gillespie Jun. 1986 22 p
(AD-A174767; AD-E900632; NWC-TP-6733) Avail: NTIS HC A02/MF A01 CSCL 20/6

We derive from Maxwell's equations a set of three coupled first-order differential equations for high-frequency light ray trajectories in a medium whose index of refraction n(r) at any point r is a function only of r. GRA

N87-19067# Brookhaven National Lab., Upton, N. Y.
COHERENT BACKSCATTERING IN THE SOFT X-RAY REGION
G. Matone and A. Luccio Jun. 1986 50 p
(Contract DE-AC02-76CH-00016)
(DE86-015945; BNL-38460) Avail: NTIS HC A03/MF A01

It is shown that coherent polarized soft X-rays can be produced by a combination of two techniques - stimulated amplification of laser light in a magnetic undulator, and Compton scattering of laser photons on an electron beam. In the combined technique, laser radiation is Compton scattered from a relativistic electron beam, whose current or charge density is periodically modulated. An electron beam and a laser beam propagate through an undulator along the same line. Inside the undulator, the laser electromagnetic waste produces a modulation of the electron energy. After some drift space, the modulation of the electron energy transforms into a modulation of the beam longitudinal charge density. The laser photons are reflected by a concave mirror against the electrons and are backscattered. In the process, their energy is greatly increased. If the electron and laser photon energy are matched properly, the modulated electron beam may act as a moving diffraction grating, and the backscattered X-rays show a high degree of coherence. The mechanism of modulation is described. The effects of electron beam energy spread, finite electron beam emittance, and undulator imperfections are discussed. The theory of scattering of a light wave by a bunched electron beam and the properties of the scattered radiation are examined. DOE

N87-19068# Sandia National Labs., Albuquerque, N. Mex.
SINGLE CRYSTAL INTEGRATION OF AN OPTICAL INTERFERENCE FILTER AND PHOTODIODE
P. L. Gourley, R. M. Biefeld, and T. E. Zipperian 1986 6 p Presented at the International Symposium on Gallium Arsenide and Related Compounds, Las Vegas, Nev., 28 Sep. 1986
(Contract DE-AC04-76DP-00789)
(DE87-000457; SAND-86-2088C; CONF-8609150-2) Avail: NTIS HC A02/MF A01

An all-semiconductor, single-crystal, integrated optical detector has been produced for the visible, in which a photodiode and an optical interference filter (high reflector) were integrated in a single growth run by metal-organic chemical vapor deposition. In this structure, the high reflector is both optically and electrically active, being composed of alternating, doped, quarter-wave layers of GaP and GaAs sub 0.2 P sub 0.8. The diode is a p-n junction superlattice composed of much thinner layers of GaP and GaAs sub 0.35 P sub 0.65. The photodiode responds to light from 460 to 600 nm, while the high reflector rejects a narrow 10 nm band centered near 500 nm. The rejection factor is approx. 7 db for these prototype devices. The quantum efficiency, linearity, temperature and bias dependence of the spectral response are reported. DOE

N87-18747# Naval Weapons Center, China Lake, Calif.
CONSIDERATIONS IN UTILIZING IR SIGNATURES Abstract Only
Wayne H. Tanaka *In* AGARD Multifunction Radar for Airborne Applications Jul. 1986 1 p (For primary document see N87-18721 11-32)
Avail: NTIS HC A10/MF A01

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N87-19069# Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
THE 13TH CZECHOSLOVAK SEMINAR ON PLASMA PHYSICS AND TECHNOLOGY
Sep. 1985 154 p Seminar held in Liblice, Czechoslovakia, 13-15 May 1985
(IPPCZ-253) Avail: NTIS HC A08/MF A01

Topics addressed include: low temperature plasmas; computerized simulation; Langmuir turbulence; photoemission-absorber detection systems; shock wave generation; Monte Carlo simulation of collided plasma ions; reactive magnetron sputterin; Castor Tokamak; Alfven current drive; circuit breaking arcs; plasma compression; and nonlinear plasmas. For individual titles, see N87-19070 through N87-19075.

N87-19070# Ceskoslovenska Akademie Ved, Prague. Central Inst. of Electron Physics.
ON THE PLASMA DENSITY OF METAL VAPOUR ARCS IN VACUUM
B. Juettner *In its* The 13th Czechoslovak Seminar on Plasma Physics and Technology Sep. 1985 p 1 (For primary document see N87-19069 11-75)
Avail: NTIS HC A08/MF A01

In vacuum arcs, the discharge medium consists of metal vapor plasma delivered by point sources at the cathode surface. It is shown by photographs of arc spots of erosion tracks that the characteristic spot size is less than 20 microns. This value is further reduced when the spot splits into fragments. With contaminated surfaces, there frequently occur fragments visible by diverging. Fragments on clean surfaces seldom diverge, but in this case the width of the erosion track is limited so that also without fragments the diameter of the erosion area remains equal to or less than 10 microns. The consequences of this restriction for current density and plasma density are discussed. There are two possibilities to explain these short times: Joule heating of the central crater region, or ion impact heating of thin surface layers. An analysis of wall ion currents yields general estimates on the plasma density as a function of distance to the arc spot. Finally, the mechanisms of ion acceleration within the gap are discussed. Author

N87-19071# Academy of Sciences, Jena (East Germany).
STOCHASTIC PROPERTIES OF CIRCUIT BREAKING ARCS
L. Rothhardt *In* Ceskoslovenska Akademie Ved, The 13th Czechoslovak Seminar on Plasma Physics and Technology Sep. 1985 p 8-13 (For primary document see N87-19069 11-75)
Avail: NTIS HC A08/MF A01

Results are discussed for research work concerning the

influence of cooling gas turbulence onto the breaker arc and the dielectric properties of the widely used cooling gases, air, and SF6, at elevated temperatures, both needed for numerical simulation of the breaking action. B.G.

N87-19072# Ceskoslovenska Akademie Ved, Prague.
CONTROLLED REB ENERGY DEPOSITION IN AN INHOMOGENEOUS PLASMA
P. Sunka, V. Babicky, V. Bohacek, M. Clupek, K. Kolacek, I. Kovac, A. Krejci, V. Piffl, J. Raus, M. Ripa et al *In its* The 13th Czechoslovak Seminar on Plasma Physics and Technology Sep. 1985 p 63-66 (For primary document see N87-19069 11-75)
Avail: NTIS HC A08/MF A01

The heating of an inhomogenous (localized) plasma by using Relativistic Electron Beams (REBs) reflected at the virtual cathode created spontaneously near the plasma-vacuum boundary represents an alternative to the two-stage heating scheme proposed for Budker's reactor. The method is tested for the maximum plasma densities exceeding 10 to the 21st power/cubic m. The indispensable role of the reflected beam in achieving high energy deposition rates was confirmed by special experiments with a foil-terminated plasma and a moveable collector. B.G.

N87-19073# Ceskoslovenska Akademie Ved, Prague.
DYNAMICS OF STRONG LANGMUIR TURBULENCE: COMPUTER SIMULATIONS
Z. Sedlacek, K. Jungwirth, P. Stavincha, and B. N. Breizman (Akademiya Nauk SSSR, Novosibirsk) *In its* The 13th Czechoslovak Seminar on Plasma Physics and Technology Sep. 1985 p 67-88 (For primary document see N87-19069 11-75)
Avail: NTIS HC A08/MF A01

Results of several computational runs modeling the free-evolving strong turbulence of Langmuir waves (LW) with group velocities exceeding those of the ion sound are presented. The dimensionless spatially one-dimensional set of Zakharov equations is solved by using a pseudospectral computer code. In all runs performed, modulation processes were dominant, masking completely any weakly turbulent redistribution of free LW energy. B.G.

N87-19074# Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
TRIGATRON SWITCH FOR H. V. PULSE GENERATORS
V. Bohacek *In its* The 13th Czechoslovak Seminar on Plasma Physics and Technology Sep. 1985 p 89-95 (For primary document see N87-19069 11-75)
Avail: NTIS HC A08/MF A01

The circuit diagram for one of the pulse generator trigger systems, employing the trigatron nonpressurized air spark gap and an output transmission cable charged up to an operating voltage as high as +40 kV dc, is presented. Delay time, jitter, and trigatron working range were measured as a function of the magnitude and polarity of the switch hold-off voltage; the magnitude, polarity, and rate of rise of the trigger voltage; and the geometry of an ignition chamber around the irradiating electrode. The data presented demonstrate conclusively that the trigatron switch is acceptable from the standpoint of present requirements and that is performance specification could be simply improved by varying the geometry of the ignition chamber. B.G.

N87-19075# Karlova Univ., Prague (Czechoslovakia). Dept. of Electronics and Vacuum Physics.
MEASUREMENTS WITH LANGMUIR PROBES AT MEDIUM PRESSURES
M. Tichy, P. David, and M. Sicha *In* Ceskoslovenska Akademie Ved, The 13th Czechoslovak Seminar on Plasma Physics and Technology Sep. 1985 p 96-98 (For primary document see N87-19069 11-75)
Avail: NTIS HC A08/MF A01

The classical collisionless Langmuir probe technique for determining the electron density and temperature in a plasma is only applicable at low pressures where the characteristic parameters, Knudsen number and Debye ratio are large. At medium pressures, it is necessary to apply a correction to the data from the Languir probe which takes into account the collisions of charged particles with the neutrals in the sheath. The correction according to the theory developed by Kopiczynski and Zakrzewski is applied to the ion saturation current and expanded down to lower Knudsen numbers. Measurements were performed for Knudsen numbers. B.G.

N87-19076# Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
POWER DEPENDENCE OF THE REFLECTION COEFFICIENT AT LOWER HYBRID HEATING
V. A. Petrzilka, R. Klima, and P. Pavlo Jan. 1986 17 p
(IPPCZ-262) Avail: NTIS HC A02/MF A01

Due to the ponderomotive action of the radiofrequency (RF) field at the plasma edge, conditions for minimizing the power reflection coefficient R sup 2 can change considerably with increasing the RF power. Dependences of R sup 2 on the unperturbed edge plasma density and on the RF power density are computed for a series of illustrative examples. Author

N87-19077# Nagoya Univ. (Japan). Inst. of Plasma Physics.
RESONANCE EFFECTS IN ELECTRON-ION COLLISIONS
Hiroyuki Tawara, ed. and Gordon H. Dunn, ed. Oct. 1986 224 p
(IPPJ-AM-47) Avail: NTIS HC A10/MF A01

Topics addressed include: plasma modeling, diagnostics in A and M data needs in large plasma machines; atomic and molecular processes (theory); atomic and molecular processes (experiment); laboratory plasma experiments; and future collaboration of U.S. and Japanese scientists in these areas. B.G.

N87-19078# Nagoya Univ. (Japan). Inst. of Plasma Physics.
DYNAMIC PROCESSES OF HIGHLY CHARGED IONS
Yasuyuki Kanai, ed. and Shunsuke Ohtani, ed. Oct. 1986 132 p Proceedings of International Seminar on Dynamic Processes of Highly Charged Ions, Fuji, Japan, 21-23 Aug. 1986
(IPPJ-AM-48) Avail: NTIS HC A07/MF A01

Topics addressed include: charged ion specificity; ion-atom collisions; electron-ion collisions; electron impact ionization and excitation; heavy ions; energy levels; X-ray spectroscopy; electron capture; emission from overlapping resonance states; charge transfer; and photon angular distribution of radiative electron capture. Author

N87-19079# Nagoya Univ. (Japan). Inst. of Plasma Physics.
STATISTICAL PLASMA PHYSICS: PROCEEDINGS OF WORKSHOP OF US-JAPAN JOINT INSTITUTE FOR FUSION THEORY PROGRAM
Tadatsugu Hatori, ed. Sep. 1986 373 p Workshop held in Nagoya, Japan, 17-21 Feb. 1986
(IPPJ-REV-2) Avail: NTIS HC A16/MF A01

The fifth workshop proceedings are presented for a more thorough understanding of fusion technology. Understanding of profound transport phenomena in contained plasmas requires a wider range of knowledge from many fields. The workshop covers the following topics: wave phenomena, critical phenomena and selfsimilarity, structure formation, nonlinear dynamics, turbulence, strongly coupled plasmas, and acceleration/diffusion. For individual titles, see N87-19080 through N87-19103.

N87-19080*# California Univ., Berkeley. Dept. of Physics.
WAVE PACKETS AND WKB THEORY IN PHASE SPACE
Robert G. Littlejohn *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 8-13 Sponsored by NASA (For primary document see N87-19079 11-75)
(Contract DE-AC03-76SF-00098; Grant NSF PHY-82-17853)
Avail: NTIS HC A16/MF A01 CSCL 20I

A practical difficulty of traditional Wentzel-Kramer-Brillouin (WKB) theory is that it suffers from non-physical infinities at caustics. A theoretical difficulty is that it does not possess any reasonable covariance or invariance properties under transformations in phase space. It turns out that the solution of one of

these problems also solves the other, and leads to a version of WKB theory in phase space. The new theory is most easily implemented by using wave packets. Author

N87-19081# Nagoya Univ. (Japan). Dept. of Physics.
NONLINEAR COLLISIONAL DRIFT WAVES AND ION-ACOUSTIC WAVES PROPAGATING IN A MAGNETIC FIELD WITH SHEAR
Tosiya Taniuti *In its* Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 14-27 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

A collisional drift wave localized about a mode rational surface is discussed in a slab model by means of a model equation for the electrostatic potential comprising the usual nonlinear term due to the polarization drift and a collisional effect enhanced by a magnetic shear. Also an ion-acoustic wave propagating in the poloidal direction with the toroidal symmetry is studied to examine a possibility that solitons with scale of the effective ion-Larmor radius are formed. A KdV equation is derived for a plasma rotating with a speed nearly equal to the wave velocity. Author

N87-19082# Texas Univ., Austin. Inst. for Fusion Studies.
CLASS RENORMALIZATION: ISLANDS AROUND ISLANDS **c72**
James D. Meiss *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 28-51 (For primary document see N87-19079 11-75)
(Contract DE-FG05-80ET-53088)
Avail: NTIS HC A16/MF A01

An orbit of class is one that rotates about a periodic orbit of one lower class with definite frequency. This contrasts to the level of a periodic orbit which is the number of elements in its continued fraction expansion. Level renormalization is conventionally used to study the structure of quasi-periodic orbits. The scaling structure of periodic orbits encircling other periodic orbits in area preserving maps is discussed here. Fixed points corresponding to the accumulation of p/q bifurcations are found and scaling exponents determined. Fixed points for q greater than 2 correspond to self-similar islands around islands. Frequencies of the island boundary circles at the fixed points are obtained. Importance of this scaling for the motion of particles in stochastic regions is emphasized. Author

N87-19083# Nihon Univ., Tokyo (Japan). Dept. of Physics.
LONG-TIME CORRELATION IN THE TWO-WAVE HAMILTONIAN **c64**
H. Irie and T. Hatori (Nagoya Univ., Japan) *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 52-61 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

The time-correlation function of velocity is found to decay with the power law for the orbit governed by a Hamiltonian. The renormalization group technique can predict the power of decay for the correlation function. The power spectrum becomes the 1/f-type for a special case. Author

N87-19084# Waseda Univ., Tokyo (Japan). Dept. of Applied Physics.
THE f-GAMMA SPECTRUM AND STAGNANT MOTIONS IN PHASE SPACE **c64**
Yoji Aizawa *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 62-70 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

Naive mechanisms which create the f to the -nu power spectrum are discussed and some numerical simulations for the intermittency, fat fractals and homoclinic chaos are briefly reviewed. Author

N87-19085# Kyushu Univ., Fukuoka (Japan). Dept. of Physics.
GLOBAL SPECTRAL STRUCTURES OF INTERMITTENT CHAOS
Hazime Mori, Hisao Okamoto, Byon Chol So, and Shoichi Kuroki *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 71-104 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

Power spectra of intermittent chaos near its onset point is formulated in order to clarify fluctuations of periodic laminar motions caused by turbulent bursts. It is shown that the power spectra exhibit eminent peaks at selected frequencies M omega sub 0 with m=0,1,2,... and an eigenfrequency omega sub 0 of the laminar motions. The peak at zero frequency is produced by fluctuations of durations of the laminar motions, whereas the peaks at nonzero frequencies are generated by jumps of phase shifts of the laminar motions of bursts. The shape of each peak turns out to obey an inverse-power law 1/the absolute value of omega -m omega sub 0 sup sigma sub m with a universal exponent sigma sub m. For the type I intermittency caused by the saddle-node bifurcation, sigma sub 0=1, sigma sub 1=2 under normal reinjections, whereas sigma sub 0=sigma sub m=1 if reinjections are restricted to the upper half of a narrow channel of the tangent map. For the type III intermittency caused by the inverted period-doubling bifurcation, sigma sub m=3/2 for m = or is greater than 1. Author

N87-19086# Tokyo Univ. (Japan). Dept. of Physics.
COHERENT ANOMALY AND ASYMPTOTIC METHOD IN COOPERATIVE PHENOMENA
Masuo Suzuki *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 105-119 Sponsored in part by the Ministry of Education (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

A new general method is proposed to study asymptotic behaviors of cooperative systems. This is based on the appearance of coherent anomaly in mean-field-type approximations of cooperative systems. This is powerful in evaluating non-classical scaling exponents of cooperative phenomena. Author

N87-19087# Tokyo Univ. (Japan). Dept. of Nuclear Engineering.
RELAXATION PHENOMENA IN CURRENT-CARRYING TOROIDAL PLASMAS
Zensho Yoshida *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 120-132 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

A theory of intrinsic dissipative structure is developed, which is used to analyze the decay of a dissipative dynamical system. The theory is applied to the study of stable equilibria in magnetohydrodynamic (MHD) systems. Special sets of MHD equilibria are characterized as attractors of MHD systems, and they are shown to be classified into four classes, which cover wide range of experimentally observed MHD equilibria. Author

N87-19088# Hiroshima Univ. (Japan). Inst. for Fusion Theory.
SELF-ORGANIZATION PROCESS IN THREE-DIMENSIONAL MAGNETOHYDRODYNAMICS
Ritoku Horiuchi *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 133-147 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

A self-organization process of a dissipative magnetohydrodynamic plasma confined in a conducting vessel is investigated in detail by means of a variational method and a magnetohydrodynamic simulation. Several simulation runs are carried out for both compressible and incompressible media. The self-organized state for a incompressible case is given by a minimum magnetic energy condition with the constraint that the total magnetic helicity is constant, while, for an incompressible case, the system self-organizes to a maximum entropy state under the same constraint as the incompressible case. For each case magnetic reconnection

is triggered at local minimum points of the magnetic helicity density where the selective dissipation of magnetic energy effectively takes place owing to the generation of nonhelical magnetic energy modes (magnetic bubbles). It is also observed that the magnetic energy spectrum cascades toward the high wavenumber region in a relaxation phase while the helicity spectrum inversely cascades toward the low wavenumber region. Author

N87-19089# Tokyo Inst. of Tech. (Japan).
ON THE FORCES AND FLUXES IN NON-EQUILIBRIUM THERMODYNAMICS **c77**
Kazuo Kitahara *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 148-158 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

A formulation of non-equilibrium thermodynamics of continuum systems based on local equilibrium assumption is reported. Thermodynamic forces are defined from a generalized local entropy and irreversible fluxes are defined as non-advective parts of fluxes of conservative quantities. The validity of the general criterion and its generalization is discussed. Author

N87-19090# Texas Univ., Austin. Inst. for Fusion Studies.
TRANSPORT IN DRIFT WAVES
Wendell Horton *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 159-175 (For primary document see N87-19079 11-75)
(Contract DE-FG05-80ET-53088)
Avail: NTIS HC A16/MF A01

The condition for the onset of stochasticity and the nature of the ensuing transport are investigated for particle motion in two drift waves. The calculation of drift wave transport has been extensively carried out in the quasilinear and renormalized turbulence theory approximation. Considering the measured amplitudes of drift waves in confinement experiments or the amplitudes observed in numerical simulation experiments it is apparent that the transport may often be in a high amplitude regime where both approximations are inadequate. Thus, the motivation to consider the exact nonlinear motion of the particles in one and two finite amplitude drift waves is derived. Author

N87-19091# Japan Atomic Energy Research Inst., Ibaraki.
RIPPLE ENHANCED TRANSPORT OF SUPRATHERMAL ALPHA PARTICLES
K. Tani, T. Takizuka, and M. Azumi *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 176-187 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

The ripple enhanced transport of suprathermal alpha particles was studied by the newly developed Monte-Carlo code in which the motion of banana orbit in a toroidal field ripple is described by a mapping method. The existence of ripple-resonance diffusion was confirmed numerically. Another new code was developed in which the radial displacement of banana orbit is given by the diffusion coefficients from the mapping code or the orbit following Monte-Carlo code. The ripple loss of alpha particles during slowing down was estimated by the mapping model code as well as the diffusion model code. From the comparison of the results with those from the orbit-following Monte-Carlo code, it was found that all of them agree very well. Author

N87-19092# Nagoya Univ. (Japan). Inst. of Plasma Physics.
STOCHASTIC DIFFUSION IN THE STANDARD MAP
Y. H. Ichikawa, T. Kamimura, and T. Hatori *In its* Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 188-211 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

Numerical observation of stochastic diffusion in the standard map was carried out in the domain of small stochastic parameter A sub c less than A less than 1.0, where A sub c is given as (2) to the -1 power 0.9716=0.1546. Multiple periodic accelerator modes manifest their pronounced sharp resonant effect in the stochastic diffusion process even in the region of small stochastic parameters, where the fundamental accelerator modes are not allowed to exist. Author

N87-19093# Tokyo Univ. (Japan). Inst. of Physics.
SPATIOTEMPORAL COMPLEXITY IN COUPLED MAP LATTICES
Kunihiko Kaneko *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 212-225 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

Some spatiotemporal patterns of couple map lattices are presented. The chaotic kink-like motions are shown for the phase motion of the coupled lattices. An extension of the couple map lattice approach to Hamiltonian dynamics is briefly reported. An attempt to characterize the high-dimensional attractor by the extension of the correlation dimension is discussed. Author

N87-19094# Princeton Univ., N. J. Plasma Physics Lab.
REMARKS ON THE CLUMP THEORY
John A. Krommes *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 226-240 (For primary document see N87-19079 11-75)
(Contract DE-AC02-76CH-03073)
Avail: NTIS HC A16/MF A01

Further details are provided of a recently published dialog which discussed the role of the small scales in fluid clump theory. It is argued that the approximation of the clump lifetime which is compatible with exponentially rapid separation of adjacent orbits is inappropriate for the description of the dynamically important large scales. Various other remarks are made relating to the analytic treatment of strong drift-wave-like turbulence. Author

N87-19095# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
RESISTIVE DRIFT WAVE TURBULENCE AND TRANSPORT
M. Wakatani *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 241-251 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

The efforts for studying the properties of resistive drift wave turbulence by using model mode-coupling equations are presented. It may be related to the edge turbulence and the associated anomalous transport in tokamaks or in stellarator/heliotron. Author

N87-19096# Japan Atomic Energy Research Inst., Ibaraki.
NONLINEAR SATURATION OF MHD BALLOONING MODES
Takashi Tuda *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 252-264 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

The saturation mechanism of ballooning mode was studied by using a system of two-fluid equation with Maxwell equations in two dimensional geometry. At the beta value below the critical one derived from MHD analysis, electrostatic ballooning modes are unstable; and high-m (m; poloidal mode number) eddies are formed. With increasing beta value, longer wave-length modes are realized. Above the critical beta value, m=1 or m=2 modes dominate other modes and magnetic fluctuation is enhanced. Author

N87-19097# California Univ., San Diego.
TRANSPORT TOWARD THERMAL EQUILIBRIUM IN A PURE ELECTRON PLASMA
D. H. E. Dubin, T. M. ONeil, and C. F. Driscoll *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 265-279

(For primary document see N87-19079 11-75)
(Contract N00014-82-K-0621; Grant NSF PHY-83-06077)
Avail: NTIS HC A16/MF A01

A new theory of cross-magnetic field transport due to like-particle collisions was developed and experimental tests of the theory were described. The theory supercedes traditional theories of transport in the regime r sub L << lambda sub D and experimental results in this regime are consistent with the new theory rather than the traditional theory. The effects of waves on the transport process were considered, and it was found that waves are not important in the operating regime of current transport experiments, but may be more important for cryogenic plasma experiments which are currently underway. Author

N87-19098# Tokyo Univ. (Japan). Dept. of Physics.
STATISTICAL PHYSICS OF DENSE PLASMAS: GENERALIZED VISCOELASTIC THEORY OF THE GLASS TRANSITION
Setsuo Ichimaru and Shigenori Tanaka *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 280-288 Submitted for publication Sponsored by Japanese Ministry of Education, Science and Culture (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

A new statistical theory of dynamic correlations is presented for a classical one-component plasma (OCP) in strong Coulomb coupling within the generalized viscoelastic formalism. The dynamic structure factor and the coefficient of shear viscosity for the OCP in a metastable supercooled state are investigated and the possibility of a glass transition is predicted. Relevance to laboratory experiment is pointed out through analyses of the metastable-state lifetimes against homogeneous nucleation of the crystalline state. Author

N87-19099# Okayama Univ. (Japan). Dept. of Electronics.
PROPERTIES OF STRONGLY-COUPLED PLASMA IN SUPER-COOLED METASTABLE STATE AND ION PLASMA IN PENNING TRAP: NUMERICAL EXPERIMENTS
Hiroo Totsuji *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 289-303 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

Numerical experiments on the classical one-component plasma (OCP) are extended to the domain where OCP is in the supercooled liquid state beyond the first order liquid-solid transition. The supercooled metastable liquid is obtained by rapidly quenching the ordinary liquid and static and dynamic properties are analyzed. As a possibility of realizing strongly-coupled OCP in laboratories, the behavior of low temperature ions in the Penning trap is simulated and strong coupling effects are observed. Author

N87-19100# Osaka Univ. (Japan). Inst. of Laser Engineering.
SPATIAL DEPHASING OF RELATIVISTIC PLASMA WAVE IN BEAT WAVE ACCELERATION
H. Takabe and K. Mima *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 304-318 Sponsored by the Japanese Ministry of Education, Science and Culture (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

The generation of relativistic plasma wave by collinear laser lights is studied, and the effects of pump depletion and cascading of the laser lights are investigated associated with the acceleration of the electrons injected with relatively low energy. It is emphasized that in relatively early stages the combination of the pump depletion and relativistic frequency shifts leads the phase of the plasma wave to be random in space, consequently terminating efficient acceleration of the electrons. Author

N87-19101# Nagoya Univ. (Japan). Inst. of Plasma Physics.
RESONANT ION ACCELERATION BY MAGNETOSONIC SHOCK WAVES
Yukiharu Ohsawa *In its* Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 319-344 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

It is shown by theory and a relativistic, electromagnetic particle simulation that strong ion acceleration occurs in a fast magnetosonic shock wave; the maximum speed of trapped ions can be about (M sub i/M sub e) sup 1/2 times as large as the Alfven speed in a quasiperpendicular shock. The acceleration takes place even in laminar shock waves. The magnitude of the acceleration increases with omega sub ce/omega sub pe and is enhanced by finite beta effects. For a parameter regime omega sub ce/omega sub pe similiar to or > 1, highly relativistic ions and electrons are produced simultaneously in the shock ramp. The structure of a nonlinear slow wave and associated resonant ion acceleration is also discussed. Author

N87-19102# Tokyo Inst. of Tech. (Japan).
SIMULATION OF DIFFUSION IN CONCENTRATED LATTICE GASES
Klaus W. Kehr *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 345-355 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

Recently the diffusion of particles in lattice gases was studied extensively by theoretical methods and numerical simulations. Work on collective and, in particular, on tracer diffusion is reviewed. The diffusion of tagged particles is characterized by a correlation factor whose behavior as a function of concentration is now well understood. Also the detailed kinetics of the tracer transitions was investigated. A special case is the one-dimensional lattice gas where the tracer diffusion coefficient vanishes. An interesting extension is the case of tagged atoms with a different transition rate. This model allows one to study various physical situations, including impurity diffusion, percolation, and diffusion in partially blocked lattices. Finally work on diffusion in lattice gases under the influence of a drift field is reported. Author

N87-19103# Bell Telephone Labs., Inc., Murray Hill, N. J.
PLASMA DISTRIBUTION FUNCTION IN A SUPERTHERMAL RADIATION FIELD
Akira Hasegawa, Kunioki Mima (Osaka Univ., Japan), and Minh Duong-van (Lawrence Livermore National Lab., Calif.) *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 356-358 Previously announced in IAA as A85-38090 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

A plasma which is immersed in superthermal radiation suffers velocity-space diffusion which is enhanced by the photon-induced Coulomb-field fluctuations. This enhanced diffusion universally produces a power-law distribution (E/E sub 0) to the - kappa power at energy E larger than a critical energy E sub 0 where the transition energy E sub 0 and the kappa power are inversely proportional to the photon-field intensity. Author

N87-19104*# Colorado Univ., Boulder. Dept. of Astrophysical, Planetary and Atmospheric Sciences.
WAVE GENERATION AND PARTICLE TRANSPORT IN THE PLASMA SHEET AND BOUNDARY LAYER Semiannual Report
P. B. Dusenbery 26 Mar. 1987 3 p
(Grant NAGw-998)
(NASA-CR-180216; NAS 1.26:180216) Avail: NTIS HC A02/MF A01 CSCL 20I

The one and two ion beam instability was considered as a possible explanation for the observations of broadband electrostatic noise in the plasma sheet region of the geomagnetic tail. When only hot streaming plasma sheet boundary layer ions were present, no broadband waves were excited. Cold, streaming ionospheric ions can generate electrostatic broadband waves propagating in

the slow beam-acoustic mode, but the growth rates of the waves were significantly enhanced when warm boundary layer ions were presented. (Both the slow and fast beam-acoustic modes can be excited, depending on the relative ion drift.) This mode predicted that the wave intensity of the broadband noise should peak in the plasma sheet boundary layer (PSBL). Observations of less intense electrostatic waves in the lobes and plasma sheet were likely a result of the absence of warm ion beams or large ion temperatures, respectively, which resulted in smaller growth rates. The model dependence of the ion beam instability has also been studied. For cold and warm ions streaming in the same direction, researchers found wave growth peaked for wave normal angles theta = 0 deg. and wave frequencies approx. 0.1 x the electron plasma frequency. However, for anti-parallel streaming cold and warm ions, wave growth peaks near theta = 90 deg. and wave frequencies were an order of magnitude smaller. Author

N87-19105# Loughborough Univ. of Technology (England). Dept. of Mathematics.
SINGULARITY SPECTRUM OF A CRITICAL KAM TORUS
A. H. Osbaldestin and M. Y. Sarkis Mar. 1987 21 p
(MR-200) Avail: NTIS HC A02/MF A01

The f(alpha) spectrum of scaling indices for critical KAM tori in the area-preserving standards map is determined numerically. Similarities and differences between the corresponding orbits of circle maps are discussed. Author

N87-19106# Nagoya Univ. (Japan). Inst. of Plasma Physics.
TIME RESOLVED HELIUMLIKE TITANIUM SPECTRA FROM JIPP T-IIU TOKAMAK
Takako Kato, Shigeru Morita, Kuniaki Masai, and Satio Hayakawa Dec. 1986 35 p
(IPPJ-806; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

Time resolved measurements of TiXXI-TiXIX X-ray line spectra from an ohmically heated plasma with neon puffing in the JIPP T-IIU tokamak were measured with a high resolution crystal spectrometer. The spectral data were analyzed by the use of a collisional radiative model which includes the cascade contributions from highly excited states as well as the recombination processes. Researchers fitted the observed spectra with synthetic calculations taking all the possible lines into account. From the intensity ratios of the satellite lines to the resonance line, the electron temperature T sub e was obtained every 20 ms. The result indicates that the plasma is in an ionizing phase at the beginning, reaches nearly an equilibrium around 80 ms and then turns into a recombination phase thereafter following the decrease of the electron temperature. The observed intensity ratios I sub x/I sub w and I sub y/I sub w were always found more than twice larger than the theoretical ones. The discrepanices increased in the later period of the plasma after T sub e decreased, in contrast to the result by Bitter et al. who found large discrepancies in the early phase of the discharge when T sub e was low. However the experimental data of I sub z/I sub w are in good agreement with calculations when we include the inner-shell ionization of Li-like ions. The contribution of ion-ion charge exchange processes to the ion abundances and the line intensities were investigated. Author

N87-19107# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ROTATION OF A MAGNETIC FIELD
Osamu Aono and Ryo Sugihara Sep. 1986 8 p
(IPPJ-792; ISSN-0469-4732) Avail: NTIS HC A02/MF A01

It is shown by reduction to absurdity that an axially symmetric magnetic field around a cylindrical magnet can not rotate, even if the magnet rotates upon its axis of symmetry. Author

N87-19108# Nagoya Univ. (Japan). Inst. of Plasma Physics.
HYBRID CODE SIMULATION ON MODE CONVERSION IN THE SECOND HARMONIC ICRF HEATING
Kazuo Sakai, Satoshi Takeuchi, Michio Matsumoto, and Ryo Sugihara Dec. 1986 20 p
(IPPJ-807; ISSN-0469-4732) Avail: NTIS HC A02/MF A01

Ion Cyclotron Radio Frequency (ICRF) second harmonic heating of a single-species plasma is studied by using a 1 to 1.5 dimensional quasi-neutral hybrid code. Mode conversion, transmission, and reflection of the magnetosonic waves are confirmed, both for the high- and low-field-side excitations. The ion heating by waves propagating perpendicularly to the static magnetic field is also observed. Author

N87-19109# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ACCELERATION OF ENERGETIC IONS BY A NEARLY PERPENDICULAR INTERPLANETARY SHOCK
Yukiharu Ohsawa Dec. 1986 18 p
(IPPJ-808; ISSN-0469-4732) Avail: NTIS HC A02/MF A01

The theory of resonant ion acceleration which was recently developed is compared quantitatively with the acceleration of energetic ions by a quasiperpendicular shock observed by Voyager 2 at a distance of approximately 1.9 AU from the Sun. The theory explains many important features of the experimental results. Author

N87-19110# Nagoya Univ. (Japan). Inst. of Plasma Physics.
NONLINEAR PHENOMENA DUE TO AN m=1 NON-RESONANT CURRENT-DRIVEN MODE IN RFP WITH RELATIVELY HIGH S NUMBER
Noriyoshi Nakajima Dec. 1986 37 p
(IPPJ-809; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

Nonlinear phenomena due to non-resonant current-driven modes with poloidal mode number m = 1 are examined using a numerical simulation of an incompressible helical symmetric plasma with relatively high S number. It is found that the nonlinear interaction between the m = 0 and m = 1 modes brings a nonlinear oscillation immediately after the linear growth stage and subsequently a nonlinear reconnection takes place. This nonlinear oscillation occurs around a helical equilibrium in close vicinity to the initial axisymmetric equilibrium. It should be noted that the slow nonlinear reconnection occurs after the nonlinear oscillation is completely or almost completely damped out by the dissipation. The occurrence of this nonlinear reconnection is owing to the reversal of the current induced by a largely deformed helical flux function. Author

N87-19111# Naval Research Lab., Washington, D. C.
ON THE STABILITY OF A STRATIFIED SHEAR LAYER
P. Satyanarayana, Y. E. Lee, and J. D. Huba 19 Sep. 1986 20 p
(AD-A174306; NRL-MR-5841) Avail: NTIS HC A02/MF A01 CSCL 20/9

The stability of a stratified shear layer is investigated using an expcnential density profile and a laminar shear flow with a continuous velocity distribution. It is shown that an exact stability boundary can be obtained from an inhomogeneous inviscid fluid under the action of gravity without the need to impose the Boussinesq approximation. The stability boundary is given by J = k(sup 2) (1 - beta sup 2/4 - k sup 2) where Beta is the ratio of the velocity and density gradient scale sizes, J is the Richardson number and k is the perpendicular wavenumber normalized to the velocity gradient scale size; this reduces to the stability boundary derived by Drazin in the limit beta = O. The solution allows for c = beta/2 where c is the normalized phase velocity. GRA

N87-19112*# National Academy of Sciences - National Research Council, Washington, D. C.
PHYSICS THROUGH THE 1990s: PLASMAS AND FLUIDS
1986 338 p Sponsored by NASA, DOD, DOE and NSF
(NASA-CR-180055; NAS 1.26:180055; PB86-241528;
ISBN-0-309-03548-1; LC-85-10634) Avail: NTIS HC A15/MF A01 CSCL 20I

The volume contains recommendations for programs in, and government support of, plasma and fluid physics. Four broad areas are covered: the physics of fluids, general plasma physics, fusion, and space and astrophysical plasmas. In the first section, the accomplishments of fluid physics and a detailed review of its sub-fields, such as combustion, non-Newtonian fluids, turbulence, aerodynamics, and geophysical fluid dynamics, are described. The general plasma physics section deals with the wide scope of the

theoretical concepts involved in plasma research, and with the machines; intense beam systems, collective and laser-driven accelerators, and the associated diagnostics. The section on the fusion plasma research program examines confinement and heating systems, such as Tokamaks, magnetic mirrors, and inertial-confinement systems, and several others. Finally, theory and experiment in space and astrophysical plasma research is detailed, ranging from the laboratory to the solar system and beyond. A glossary is included. GRA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N87-19113 British Library Lending Div., Boston Spa (England).
HIGH-COERCIVITY SINGLE CRYSTALS OF Fe-Cr-Co-Mo ALLOYS
I. S. Belyatskaya [1987] 4 p Transl. into ENGLISH from Izvestiya Vysshikh Uchebynkh Zavedenii, Chernaya Metallurgiya (USSR), no. 8, 1986 p 154
(BLL-M-37115-(5828.4)) Avail: British Library Lending Div., Boston Spa, Engl.

Single crystals of Fe-Cr-Co-Mo alloys, grown by the Bridgman method, were investigated to clarify the possibilities of obtaining high magnetic properties in alloys based on the Fe-Cr-Co system. Author

N87-19114 British Library Lending Div., Boston Spa (England).
SPLITTING OF COORDINATION SPHERES CLOSE TO POINT DEFECTS IN ORDERED ALLOYS
M. D. Starostenkov and A. Yu. Muravev [1987] 4 p Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedenii, Chernaya Metallurgiya (USSR), no. 8, 1986 p 152-153
(BLL-M-37113-(5828.4)) Avail: British Library Lending Div., Boston Spa, Engl.

The atomic configuration close to vacant sites of the crystal lattice of alloy Ni3Fe having a variable long-range order was studied within the framework of the variational method of computer simulation. Author

N87-19115*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PROCEDURE TO PREPARE TRANSPARENT SILICA GELS Patent Application
Patrick G. Barber, inventor (to NASA) (Longwood Coll., Farmville, Va.) and Norman R. Simpson, inventor (to NASA) Filed 24 Nov. 1986 11 p
(NASA-Case-LAR-13476-1-CU; NAS 1.71:LAR-13476-1-CU; US-Patent-Appl-SN-933961) Avail: NTIS HC A02/MF A01 CSCL 20B

This invention relates to the production of silica gels and in particular to a process for the preparation of silica gels which can be used as a crystal growth medium that simulates the convection-less environment of space to produce structurally perfect crystals. Modern utilizations of substances in electronics, such as radio transmitters and high frequency microphones, often require single crystals with controlled purity and structural perfection. The near convectionless environment of silica gel suppresses nucleation, thereby reducing the competitive nature of crystal growth, and provides a medium for growing single crystals with structural perfection and controlled purity. Previous methods of producing silica gels result in cloudy, translucent gels, while it is much more desirable to produce transparent gels so that the crystals can be more easily observed. In the current process, sodium ions in a sodium silicate solution are replaced with potassium ions from a soluble potassium salt solution by using cation exchange resin beads. The resulting treated silicate solution is then added to a volume of boiled, cooled distilled water, after which a volume of acetic acid solution is added to the mixture of distilled water and treated silicate solution. This mixture is then allowed to gel at room temperature, whereby a transparent silica gel is produced. Author

N87-19116*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METHOD AND APPARATUS FOR GROWING CRYSTALS Patent Application
Robert J. Naumann, inventor (to NASA), Sandor L. Lehoczky, inventor (to NASA), and Donald O. Frazier, inventor (to NASA) Filed 31 Oct. 1986 20 p
(NASA-Case-MFS-28137-1; NAS 1.71:MFS-28137-1; US-Patent-Appl-SN-925189) Avail: NTIS HC A02/MF A01 CSCL 20B

This invention relates to a method and apparatus for bulk growth of defect-free compound crystals. Crystal growth is carried out in the present invention in an apparatus having an enclosure with a spherical interior which is provided with an adjustable heat source. A seed crystal is positioned within this interior and is connected to one end of a rod of heat conductive material which extends through the enclosure. The rod is independently heated, and a heat absorber is connected to an opposite end of the rod. Crystalline material is placed in the interior of the sphere and in engagement with the seed crystal, and pressure is applied to it. Encapsulant material having a slightly lower melting point than the crystalline material is disposed between the latter and the spherical container wall. A crystal structure is grown by heating the crystalline material up to a predetermined temperature while controlling heat dissipation through the rod by the application of heat to the rod. Heat application is reduced, allowing heat to escape via the seed crystal and the rod of material, causing the crystalline material to be deposited as a single crystal on the seed crystal. Novelty of the invention is believed to reside in the use of a spherical container with a heat removal rod at one pole of the sphere, the rod providing for control of the shape of the crystal-liquid interface during solidification. These features enable growth of relatively large, defect-free crystals of compound materials. Author

N87-19117# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
IMPURITY BANDS IN N-TYPE Si-SiO2 MOS
E. A. deAndradaeSilva and I. C. daCunhaLima Dec. 1986 15 p Submitted for publication
(INPE-4086-PRE/1031) Avail: NTIS HC A02/MF A01

The density of states (DOS) for N(+) sub a impurity bands in n-type Si/SiO2 MOS structures with a Hubbard-like model are calculated, using as a basis Martin and Wallis single-impurity states. It is shown that the intrasite correlation energy increases with the applied electric field on the junction. The same occurs with the bandwidth and with the energy corresponding to the maximum in the DOS. This effect is enhanced by increasing the impurity concentration, Nox. The asymmetry of the DOS explains why the measured binding energy for finite Nox is smaller than in the single-impurity case. Author

N87-19118# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
METAL-INSULATOR TRANSITIONS IN DOPED SILICON AND GERMANIUM
A. FerreiradaSilva Dec. 1986 9 p Submitted for publicaton
(INPE-4089-PRE/1034) Avail: NTIS HC A02/MF A01

The effect of including conduction band minima into the calculation of metal-insulator transitions proposed for doped silicon is investigated using the variation of the effective wave function and the interference factor due to the minima. The calculations are extended for doped germanium. Good agreements with experiments are found. Author

N87-19119# Michigan Technological Univ., Houghton.
ENERGY TRAPPING, RELEASE, AND TRANSPORT IN THREE DIMENSIONAL ENERGETIC SOLIDS AND MOLECULAR CRYSTALS Final Report, 1 Jul. 1981 - 30 Jun. 1986

A. B. Kunz 30 Jun. 1986 290 p
(Contract N00014-81-K-0620)
(AD-A174012) Avail: NTIS HC A13/MF A01 CSCL 07/3

This report describes the development and implementation of a general theoretical approach to describing the properties of defects and impurities in non-metallic solid systems as well as its bulk properties. This approach combines fully correlated, fully self consistent electronic structure determination of the electrical and mechanical properties associated with neutral or charged defects/impurities in or on a non-metal. The system remote from the defect is described by the shell model which incorporates self consistently, host polarization and distortion. This results in our being able to obtain absolute energies of the impurity ions in the host and their interaction. The model is free of adjustable or undefined parameters. This project is of non-trivial magnitude and the current computer implementation, consists of a program, ICECAP, which is about 100,000 statements long. GRA

N87-19120# California Univ., Santa Barbara.
MINORITY-CARRIER INVESTIGATIONS OF BEAM-ANNEALED AND THERMALLY-ANNEALED SEMICONDUCTORS Final Report, Oct. 1981 - Oct. 1985
James L. Merz Sep. 1986 57 p
(Contract F19628-82-K-0006)
(AD-A174334; RADC-TR-85-272) Avail: NTIS HC A04/MF A01 CSCL 20/12

The effect of beam-processing on III-IV compound semiconductors, particularly indium phosphide (InP), has been investigated. Two types of beams have been used to anneal ion-implantation damage, scanned CW Argon ion laser beams, and incoherent radiation focussed on the sample. Two different but related problems have been addressed. (1) The problem of accurately measuring the equilibrium temperature of the sample in the region that is heated by a focussed CW laser beam has been studied using novel techniques: in-situ high-temperature photoluminescence and Raman-scattering measurement. Accurate temperature measurements for this case have been obtained for the first time; far less spatial dependence of the thermal profiles has been observed than predicted. (2) Rapid thermal annealing of ion-implanted InP was studied for a variety of implant and anneal conditions using low-temperature photoluminescence, Raman scattering, and Rutherford backscattering. The results of all three characterization techniques were self-consistent, and showed that, in order to obtain single-crystal material with high electrical activation, it is necessary to perform the implants at an elevated temperature, (approx. 200 C) and to anneal at as high a temperature as possible without causing significant dissociation. GRA

N87-19121# Ames Lab., Iowa.
ELECTRON SPIN-LATTICE RELAXATION IN HYDROGENATED AMORPHOUS SEMICONDUCTORS Ph.D. Thesis
S. Dey Aug. 1986 212 p
(Contract W-7405-eng-82)
(DE86-015766; IS-T-1273) Avail: NTIS HC A10/MF A01

Electron spin resonance (ESR) methods have been used to measure the temperature dependence of the spin-lattice relaxation time T of dangling bond electrons in hydrogenated amorphous and silicon carbide films (a-Si:H and a-Si-C:H) prepared by reactive radiofrequency sputtering. T determinations were made using absorption mode saturation technique. The microwave radiofrequency field H was calibrated by an independent determination of T using the periodic adiabatic passage technique. Measurements made over the temperature range 100 to 400K showed T proportional to T(-2) behavior. Measurements in the 100 to 400K temperature range are valuable for distinguishing among possible spin-lattice relaxation mechanisms. At these temperatures, dominance of the direct process appears most unlikely. Therefore, phonon-bottlenecking caused by oxygen contamination of the sample surface, which in conjunction with the direct process can lead to T proportional to T(-2) dependence, can be ruled out. Rather, the two-level system (TLS) relaxation mechanism which applies generally to amorphous materials and which also yields T proportional to T(-2) behavior appears to be responsible in the present case. This follows from the fact that the a-Si:H and a-Si-C:H samples remained amorphous over the entire temperature range studied. DOE

N87-19122# Lawrence Livermore National Lab., Calif.
EVALUATION OF SOLID STATE SUPERLATTICES FOR USE IN LABORATORY PROGRAMS
W. J. Orvis and J. H. Yee Aug. 1986 19 p
(Contract W-7405-eng-48)
(DE86-015952; UCID-20860) Avail: NTIS HC A02/MF A01

We have performed an evaluation of solid superlattices for use in laboratory programs. This evaluation consisted simply of a literature search on solid state superlattices, looking for basic theory and for novel devices and designs that could be useful in the laboratory. While the bulk of these papers are directed towards fiber-optic communications (lasers and detectors) there was an amazing variety of proposed devices that could do everything from measuring the oxygen content in a hydrogen atmosphere to infrared detectors and microwave lenses. There are a large number of devices that show promise for use in laboratory programs, including: adjustable frequency infrared detectors, high-gain, low-noise electron multipliers, UV or X-ray light sources using non-relativistic electrons, low noise photon detectors or switches, microwave detectors/optical modulators, high frequency microwave oscillators, etc. DOE

N87-19123# Oak Ridge National Lab., Tenn. Solid State Div.
LATTICE DYNAMICS OF CRYSTALLINE IODINE
H. G. Smith, C. B. Clark, and M. Nielsen 1986 6 p Presented at the Dynamics of Molecular Crystals Conference, Grenoble, France, 30 Jun. 1986 Prepared in cooperation with North Carolina Univ., Greensboro and Research Establishment Risoe, Roskilde, Denmark
(Contract DE-AC05-84OR-21400)
(DE86-012624; CONF-8606156-1) Avail: NTIS HC A02/MF A01

Phonon dispersion curves of a single crystal of iodine have been measured by coherent inelastic neutron scattering on a triple-axis spectrometer at 77 K. The data have been analyzed in terms of three Buckingham-six potential functions. DOE

N87-19124# Argonne National Lab., Ill. Chemistry Div.
MEASUREMENTS OF THE MICROWAVE CONDUCTIVITY OF THE ORGANIC SUPERCONDUCTOR ET2 (IAuI)
D. B. Tanner, C. S. Jacobsen, J. M. Williams, and H. H. Wang 1986 7 p Presented at the International Conference on Science and Technology of Synthetic Metals, Kyoto, Japan, 1 Jun. 1986 Prepared in cooperation with Technical Univ. of Denmark, Lyngby
(Contract W-31-109-eng-38)
(DE86-014206; CONF-8606133-8) Avail: NTIS HC A02/MF A01

The microwave conductivity of ET2(IAuI), which is superconducting below 4 K, has been measured between 20 and 300 K. The measurements were done by cavity perturbation at 35 GHz for electric field along the highly conducting direction. The samples were in the skin-depth limit. The room temperature conductivity is quite low, approximately 6 mu/cm. With a decrease in temperature the conductivity increases as T sup -2 reaching nearly 900 mu/cm at 20 K. These values are rather close to extrapolations of the frequency-dependent conductivity determined from far-infrared experiments. DOE

N87-19125# Oak Ridge National Lab., Tenn. Solid State Div.
LOW-TEMPERATURE EPITAXIAL GROWTH OF Si AND Ge AND FABRICATION OF ISOTOPIC HETEROSTRUCTURES BY DIRECT ION BEAM DEPOSITION (IBD)
B. R. Appleton, S. J. Pennycook, R. A. Zuhr, N. Herbots, and T. S. Noggle 1986 19 p Presented at the 5th International Conference on Ion Beam Modification of Materials, Catania, Italy, 9 Jun. 1986
(Contract DE-AC05-84OR-21400)
(DE86-014218; CONF-8606101-6) Avail: NTIS HC A02/MF A01

Direct ion beam deposition (IBD) is utilized to deposit isotopic thin films and heterostructures and to achieve high-quality epitaxial growth of Ge-74 on Ge(100) and Si-30 on Si(100) at temperatures

as low as 400 C. Anomalous damage is observed during IBD at 400 and 600 C that results in a band of buried loops at depths 50 times normal and a defect-free region near the original surface. An unexplained doping effect is reported for epitaxial growth of Si on Si at 20 to 40 eV, 400 C where high-quality epitaxy occurs on n-type Si but amorphous films form on p-type. DOE

N87-19126# Georgia Inst. of Tech., Atlanta. School of Physics.
STRUCTURE AND REACTIVITY OF HETEROGENEOUS SURFACES AND STUDY OF THE GEOMETRY OF SURFACE COMPLEXES Progress Summary Report, 1 Jan. - 31 Dec. 1986
U. Landman 1986 22 p
(Contract DE-FG05-86ER-45234)
(DE87-000325; DOE/ER-45234/T1) Avail: NTIS HC A02/MF A01

Research has concentrated on the structure and dynamics of the solid-melt interface of silicon and the dynamics of silicon growth from the melt. Additional research concerns the structure and dynamics of small clusters, isomerization and melting of small alkali-halide clusters, and the structure and dynamics of surfaces and adsorption systems. DOE

N87-19127# California Univ., Berkeley.
STABILITY OF THE Si LATTICE: ELECTRON-PHONON INTERACTIONS AND SUPERCONDUCTIVITY IN HEXAGONAL Si
D. Erskine, P. Y. Yu, K. J. Chang, and M. L. Cohen Aug. 1986 7 p Presented at the 18th International Conference on Physics of Semiconductors, Stockholm, Sweden, 11 Aug. 1986
(Contract DE-AC03-76SF-00098)
(DE87-000928; LBL-21990; CONF-860892-3) Avail: NTIS HC A02/MF A01

Using ab initio pseudopotentials the properties of electrons, phonons and electron-phonon interactions in highly compressed Si have been computed. In particular, the hexagonal phases have been predicted to be superconducting by this calculation. The superconducting transition temperature for hexagonal Si has been measured for pressures between 16 to 45 GPa and compared to the theoretical value. DOE

N87-19128# Sandia National Labs., Albuquerque, N. Mex.
GaAs/In/SUB x/Al/SUB 1-x/As (0 LESS THAN OR EQUAL TO x LESS THAN OR EQUAL TO 0.006) INDIRECT BANDGAP SUPERLATTICES
T. J. Drummond, E. D. Jones, H. P. Hjalmarson, and B. L. Doyle Sep. 1986 7 p Presented at the 11th Annual Symposium of the Uranium Inst., London, England, 3 Sep. 1986
(Contract DE-AC04-76DP-00789)
(DE87-000975; SAND-86-2062C; CONF-860915-3) Avail: NTIS HC A02/MF A01

To explain transport data in unipolar superlattice diode structures it is necessary to assume that, for a sufficiently short period, AlAs/GaAs superlattices have an indirect bandgap. By using appropriately designed superlattices grown by molecular beam epitaxy, the supperlattice GAMMA band is moved sufficiently far above the X bands that luminescence from these bands is clearly observed for the first time. DOE

N87-19129# California Univ., Berkeley.
PHOTOPHYSICAL PROPERTIES OF MOLECULES NEAR METAL AND SEMICONDUCTOR SURFACES Ph.D. Thesis
A. P. Alivisatos Sep. 1986 157 p
(Contract DE-AC03-76SF-00098)
(DE87-001717; LBL-22225) Avail: NTIS HC A08/MF A01

Theoretical and experimental work on the interaction of a molecular excited state with a smooth metal substrate is reviewed. In order to test the classical model, we have measured the distance dependent lifetime of 3n pi * Biacetyl separated from a Ag(111) crystal by spacer layers ranging in thickness from 28 to 457A. The classical theory of energy transfer is applied here to molecule-semiconductor energy transfer. The energy transfer rate from molecules emitting throughout the visible to Si and GaAs have been computed using this model. Energy transfer from 3n pi* pyrazine to GaAs(110) has been studied experimentally. The fluorescence decay function of pyrene separated from Si(III) by Xe spacer layers has been measured as a function of coverage, wavelength and spacer thickness. DOE

N87-19130# Sandia National Labs., Albuquerque, N. Mex.
EPITAXIAL SEMICONDUCTOR OPTICAL INTERFERENCE FILTERS
P. L. Gourley, R. M. Biefeld, T. J. Drummond, and T. E. Zipperian 1987 5 p Presented at the Southwest Optics Conference, Albuquerque, N. Mex., 9 Feb. 1987
(Contract DE-AC04-76DP-00789)
(DE87-003153; SAND-86-2487C; CONF-870220-5) Avail: NTIS HC A02/MF A01

This paper reviews experimental work in two materials systems: (1) filters fabricated with alternating layers of GaP and GaAsP grown by metal-organic chemical vapor deposition; and (2) filters of AlGaAs, AlAs, or GaAs grown by molecular beam epitaxy. DOE

N87-19131*# National Academy of Sciences - National Research Council, Washington, D. C.
PHYSICS THROUGH THE 1990s: CONDENSED-MATTER PHYSICS
1986 323 p Sponsored by NASA, DOD, DOE and NSF
(NASA-CR-180056; NAS 1.26:180056; PB86-241478;
ISBN-0-309-03577-5; LC-85-21778) Avail: NTIS HC A14/MF A01 CSCL 20L

The volume presents the current status of condensed-matter physics from developments since the 1970s to opportunities in the 1990s. Topics include electronic structure, vibrational properties, critical phenomena and phase transitions, magnetism, semiconductors, defects and diffusion, surfaces and interfaces, low-temperature physics, liquid-state physics, polymers, nonlinear dynamics, instabilities, and chaos. Appendices cover the connections between condensed-matter physics and applications of national interest, new experimental techniques and materials, laser spectroscopy, and national facilities for condensed-matter physics research. The needs of the research community regarding support for individual researchers and for national facilities are presented, as are recommendations for improved government-academic-industrial relations. GRA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N87-19132# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PROGRAM CALCULATION OF THERMODYNAMIC PROPERTIES [PROGRAMA DE CALCULO DAS PROPRIEDADES TERMODINAMICAS]
Walter Gill, Fernando Fachini Filho, and Ronaldo RibeirodeOliveira Dec. 1986 20 p In PORTUGUESE; ENGLISH summary Presented at the Seminary of the Academic Association of Sao Paulo State Univ.
(INPE-4077-RPE/529) Avail: NTIS HC A03/MF A01

The determination of the thermodynamic properties are examined through the basic equations such as: state equation (Beattie-Bridgeman Form), saturation pressure equation, specific heat constant pressure or constant volume equation, and specific volume or density of liquid equation. Author

N87-19133# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
[ACTIVITIES REPORT IN PHYSICS AND HIGH ENERGY PHYSICS] Annual Report, 1983
Bob Jongejans, ed. 1985 135 p
(ETN-87-99148) Avail: NTIS HC A07/MF A01

Research in high energy physics; electron scattering; physics with pions, muons, and antiprotons; radiochemistry; and theoretical physics is summarized. ESA

N87-19134*# National Academy of Sciences - National Research Council, Washington, D. C.
PHYSICS THROUGH THE 1990s: GRAVITATION, COSMOLOGY AND COSMIC-RAY PHYSICS
1986 186 p Sponsored by NASA, DOD, DOE and NSF
(NASA-CR-180057; NAS 1.26:180057; PB86-241486;
ISBN-0-309-03579-1; LC-85-32019) Avail: NTIS HC A09/MF A01 CSCL 20J

The volume contains recommendations for space-and ground-based programs in gravitational physics, cosmology, and cosmic-ray physics. The section on gravitation examines current and planned experimental tests of general relativity; the theory behind, and search for, gravitational waves, including sensitive laser-interferometric tests and other observations; and advances in gravitation theory (for example, incorporating quantum effects). The section on cosmology deals with the big-bang model, the standard model from elementary-particle theory, the inflationary model of the Universe. Computational needs are presented for both gravitation and cosmology. Finally, cosmic-ray physics theory (nucleosynthesis, acceleration models, high-energy physics) and experiment (ground and spaceborne detectors) are discussed. GRA

N87-19089# Tokyo Inst. of Tech. (Japan).
ON THE FORCES AND FLUXES IN NON-EQUILIBRIUM THERMODYNAMICS
Kazuo Kitahara *In* Nagoya Univ. Statistical Plasma Physics: Proceedings of Workshop of US-Japan Joint Institute for Fusion Theory Program Sep. 1986 p 148-158 (For primary document see N87-19079 11-75)
Avail: NTIS HC A16/MF A01

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N87-19135# Office of Management and Budget, Washington, D.C.
A FIVE-YEAR PLAN FOR MEETING THE AUTOMATIC DATA PROCESSING AND TELECOMMUNICATIONS NEEDS OF THE FEDERAL GOVERNMENT
Sep. 1986 362 p Prepared in cooperation with General Services Administration, Washington, D.C. and Commerce Dept., Washington, D.C.
Avail: NTIS HC A16/MF A01; also available SOD HC $17.00 as 041-001-00312-6

The fourth Five-Year Automatic Data Processing (ADP) and Telecommunications Plan issued by the Office of Management and Budget (OMB) is given. This year's plan provides information on significant agency information technology initiatives and strategies, descriptions of several major Federal information systems designated for continuing senior management review and a list of all major Federal information systems. The plan also provides Federal managers with information about current trends and issues in the fields of ADP and telecommunications. Author

N87-19136# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
MINIMIZING THE EXPECTED WEIGHTED NUMBER OF TARDY JOBS IN STOCHASTIC FLOW SHOPS
O. J. Boxma and F. G. Forst May 1986 13 p Submitted for publication
(CWI-OS-R8605; B8674413; ETN-87-99517) Avail: NTIS HC A02/MF A01

Stochastic scheduling involving a single machine and involving a flow shop consisting of an arbitrary number of machines is discussed. In both problem types, all jobs to be processed have due dates, and the objective is to find a job sequence that minimizes the expected weighted number of tardy jobs. For the single-machine case, sufficient optimality conditions for job sequences are derived for various choices of due date and processing time distributions. For the case of a flow shop with an arbitrary number of machines and identically distributed due dates for all jobs, it is proved that when all jobs have the same processing time distributions, the expected weighted number of tardy jobs is minimized by sequencing the jobs in decreasing order of the weights; when all weights are equal, the jobs should be sequenced according to an increasing stochastic ordering of the processing time distributions. ESA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N87-19137 British Library Lending Div., Boston Spa (England).
SYNTHESIS OF LUMPED-DATA BASE IN CONSTRUCTING AN INTERACTIVE SYSTEM
V. V. Zimin, S. M. Kulakov, K. A. Zimina, and B. N. Piunov [1987] 10 p Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedenii, Chernaya Metallurgiya (USSR), no. 8, 1986 p 132-136 (BLL-M-37105-(5828.4)) Avail: British Library Lending Div., Boston Spa, Engl.

The possibilities of ensuring a sufficiently fast data-base response to queries from users are considered. Two procedures for constructing a data base of data that have been lumped together are described. One is suitable for a data base of the centralized type, while the second has advantages for bases of a distributed type. Author

N87-19138# Naval Ocean Systems Center, San Diego, Calif.
DEFENSE TECHNICAL INFORMATION CENTER (DTIC)
Sep. 1986 3 p
(AD-A174829; NOSC/TD-987) Avail: NTIS HC A02/MF A01 CSCL 05/2

Topics briefly summarized in this leaflet from the Naval Ocean Systems Center include: Why should you send a publication to DTIC; How to determine if a publication should be sent to DTIC; Types of information to send to DTIC; Protection of information in DTIC; and Publications excluded from DTIC. GRA

N87-19139# Lawrence Livermore National Lab., Calif.
IMPLEMENTATION OF THE INTELLIGENT GATEWAY PROCESSOR USING UNIX
M. C. Berch 1986 9 p Presented at the Seminar on Integrated Power Plant Computer Communications, San Francisco, Calif., 25 Aug. 1986
(Contract W-7405-eng-48)
(DE86-015089; UCRL-95241; CONF-8608110-1) Avail: NTIS HC A02/MF A01

The Technology Information Systems (TIS) Program at Lawrence Livermore National Laboratory, jointly sponsored by several government agencies, has implemented a new approach

to systems interconnection and user interfaces. The Intelligent Gateway Processor (IGP) is an integrated package designed to provide a single user interface to a variety of systems, automate access to information resources, and provide audit logging and authorization controls. The IGP software is UNIX-based, but the IGP approach is applicable to any heterogeneous environment. This paper discusses the implementation of the IGP software: why UNIX was chosen (and retained); the role of the individual IGP modules; how they were written to fit into (and improve on) the UNIX concept; and plans for the future of the IGP concept. DOE

N87-19140# Mound Lab., Miamisburg, Ohio.
HADES PC NETWORK: AN AUTOMATED DATA ENTRY SYSTEM
D. L. Hegemann 12 Sep. 1986 12 p
(Contract DE-AC04-76DP-00053)
(DE86-015553; MLM-MU-86-69-0002) Avail: NTIS HC A02/MF A01

Mound's Health Physics section is faced with an increasing need to store and retrieve radiological data. This need has been addressed by the Health Physics Automated Data Entry System (HADES) which assumed a full production status on April 1, 1986. Mound's Technical Computer Support group implemented HADES in a series of phases which allowed high priority needs to be immediately supported. As a result of the system's personal computer-based structure, additional capabilities such as automated data acquisition were easily brought on-line. Since its inception in the first quarter of 1984, HADES has matured into a cost-efficient automated data acquisition system for Mound's Health Physics section. DOE

N87-19141# Oak Ridge National Lab., Tenn.
SUBJECT KEYWORDS INDEX FOR THE CARBON DIOXIDE INFORMATION CENTER'S BIBLIOGRAPHIC INFORMATION SYSTEM
R. E. Millemann and R. M. Cushman Oct. 1986 37 p
(Contract DE-AC05-84OR-21400)
(DE87-001619; ORNL/CDIC-15; ESD-Publ-2763) Avail: NTIS HC A03/MF A01

Keywords (descriptors) are listed that are used to retrieve records from the Carbon Dioxide Information Center's Bibliographic Information System, which is a computerized data base of about 8,600 records on the carbon cycle, effects of atmospheric carbon dioxide on vegetation, climatology (especially as affected by carbon dioxide), and effects of climate on sea level and natural resources (e.g., agriculture, water resources, forestry, ecology, fisheries, and human health). The list of keyworks may be expanded in the future as additional descriptors are needed. DOE

N87-19142# Geological Survey, Reston, Va. National Mapping Div.
COMPUTER-BASED LIBRARY REFERENCE SYSTEM
M. E. Graziani and O. Kays Jul. 1986 55 p
(PB86-248259; OFR-86-003) Avail: NTIS HC A04/MF A01 CSCL 05B

The U.S. Geological Survey National Mapping Division's Office of Research established a reference collection to supplement the Geological Survey Library's reference works in the fields of traditional and automated cartography, geography and geographic information systems, remote sensing technology, photogrammetry, surveying and map projections. A traditional card catalog was created, using a microcomputer to facilitate the printing of the cards and to provide an automated means for machine searching and printing of bibliographies, accession lists, and other publications. To generate the card catalog, several commercial and public-domain computer programs were tested, but none fuily answered the needs of the office. An experiment with dBase II, a general-purpose data base management program, was conducted and proved successful. The file structure and some of the principal command files used to develop the computer-based library reference system are described in the publication. GRA

N87-19143# Syracuse Univ., N. Y.
ACADEMIC LIBRARY USE OF NTIS (NATIONAL TECHNICAL INFORMATION SERVICE): SUGGESTIONS FOR SERVICES AND CORE COLLECTIONS
C. R. McClure and P. Hernon Oct. 1986 70 p Sponsored by NTIS Prepared in cooperation with Simmons Coll., Boston, Mass.
(PB86-228871; ISBN-0-934213-04-6) Avail: NTIS HC A04/MF A01 CSCL 05B

The U.S. NAtional Technical Information Service (NTIS) offers a diverse range of important information resources for the physical, social, behavioral, and life sciences. Indeed, these information resources, available in both print and nonprint formats, constitute an essential type of Federally-distributed information and should not be ignored by information professionals. The manual is intended to assist academic librarians, and other information professionals, in better exploiting these information resources available through NTIS. It offers a number of practical suggestions and strategies for making NTIS information services and products available through academic libraries. The role of academic librarians in assisting the academic community with access to NTIS resources should be a natural and positive one. Both NTIS and the academic library community can work together and increase the range of valuable information resources available to faculty, students, and other clientele served by college and university libraries. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N87-19144*# Denver Research Inst., Colo. Industrial Economics and Management Div.
NASA PARTNERSHIP WITH INDUSTRY: ENHANCING TECHNOLOGY TRANSFER
Jul. 1983 290 p
(Contract NASw-3466)
(NASA-CR-180163; NAS 1.26:180163) Avail: NTIS HC A13/MF A01 CSCL 05A

Recognizing the need to accelerate and expand the application of NASA-derived technology for other civil uses in the United States, potential opportunities were assessed; the range of benefits to NASA, industry and the nations were explored; public policy implications were assessed; and this new range of opportunities were related to current technology transfer programs of NASA. B.G.

N87-19145*# Vanderbilt Univ., Nashville, Tenn. Center for the Space Processing of Engineering Materials.
[ACTIVITIES OF THE CENTER FOR THE SPACE PROCESSING OF ENGINEERING MATERIALS] Annual Report, 1 Oct. 1985 - 31 Oct. 1986
[1986] 122 p Sponsored by NASA
(Grant NAGw-810)
(NASA-CR-180171; NAS 1.26:180171; AR-1) Avail: NTIS HC A06/MF A01 CSCL 05A

Topics addressed include: containerless processing and purification; directional and rapid solidification; high temperature alloys; oxidation resistant niobium alloys; metallic bonding; effects of solidification mode on structure-property relationships; and dispersion strengthened metal alloys. Each of the projects is reported by company association and follow according to alphabetical order of the company names. B.G.

N87-19146# Naval Postgraduate School, Monterey, Calif.
A SUMMARY OF THE NAVAL POSTGRADUATE SCHOOL RESEARCH PROGRAM Summary Report, 1 Oct. 1984 - 30 Sep. 1985
30 Sep. 1986 394 p
(AD-A174795; NPS-012-86-003) Avail: NTIS HC A17/MF A01 CSCL 05/2

This report contains 227 summaries of research projects which were carried out under funding to the Naval Postgraduate School Research Program. This research was conducted under the areas of Computer Science, Mathematics, Administrative Sciences, Operations Research, National Security Affairs, Physics, Electrical and Computer Engineering, Meteorology, Aeronautics, Oceanography, and Mechanical Engineering. The table of contents identifies specific research topics. GRA

N87-19147# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ADVANCED ELECTRIC VEHICLE POWERTRAIN (ETX-I) PERFORMANCE: VEHICLE TESTING
J. E. Fenton and P. B. Patil 1986 7 p Presented at the 8th International Electric Vehicle Symposium, Washington, D.C., 20 Oct. 1986 Prepared in cooperation with Ford Motor Co., Dearborn, Mich.
(Contracts DE-AC07-76ID01570; DE-AC08-82NV-10308)
(DE87-000481; EGG-M-23786; CONF-8610122-5) Avail: NTIS HC A02/MF A01

The ETX-I powertrain represents the most advanced electric vehicle technology in operation today. This powertrain was developed by Ford Motor Company and General Electric Company as a major element of the US Department of Energy's Electric and Hybrid Vehicle program. During the final phase of this program, a vehicle test plan was developed, test requirements defined, and procedures carefully followed to measure the acceleration, gradability, and energy consumption performance of the powertrain and to characterize component efficiencies. An electric chassis dynamometer was used for the majority of the tests to minimize test variability. DOE

N87-19148# Ford Motor Co., Dearborn, Mich.
EXT-II: A SECOND GENERATION ADVANCED 2AC PROPULSION SYSTEM
B. Bates, P. B. Patil, and M. F. Ciccarelli 1986 6 p Presented at the 8th International Electric Vehicle Symposium, Washington, D.C., 20 Oct. 1986 Prepared in cooperation with General Electric Co., Schenectady, N.Y.
(Contract DE-AC07-76ID-01570)
(DE87-000482; EGG-M-24086; CONF-8610122-7) Avail: NTIS HC A02/MF A01

This paper discusses the characteristics of the concept and includes discussion of the system constraints, including traction battery constraints, and brief descriptions of the major subsystems being developed. The components discussed include: the system controller, dc to ac inverter, an internal permanent magnet ac motor and a two-speed automatic transmission with an integral final drive and differential. The motor and transmission are on a common axis and are integrated into one compact unit that is integral with the rear axle of the vehicle. DOE

N87-19149# General Electric Co., Schenectady, N.Y.
ADVANCED ELECTRIC VEHICLE POWERTRAIN (ETX-I) PERFORMANCE: COMPONENT TESTING
R. D. King and P. T. Koneda 1986 9 p Presented at the 8th International Electric Vehicle Symposium, Washington, D.C., 20 Oct 1986 Prepared in cooperation with Ford Motor Co., Dearborn, Mich., and Idaho National Engineering Lab., Idaho Falls, Ida.
(Contracts DE-AC08-82NV10308; DE-AC07-76ID-01570)
(DE87-000486; EGG-M-23886; CONF-8610122-4) Avail: NTIS HC A02/MF A01

The results of powertrain testing are described, which characterizes the subsystems, evaluated performance, and determines component efficiencies. Test results were obtained using an integrated motor and transaxle installed on a dynamometer with computer controlled data acquisition. The effects of parametric variations in battery voltage and transaxle oil temperature were evaluated and test results compared against program objectives. DOE

88 SPACE SCIENCES (GENERAL)

N87-19150# European Space Agency, Paris (France).
PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM ON NEW INSIGHTS IN ASTROPHYSICS. EIGHT YEARS OF UV ASTRONOMY WITH IUE
E. J. Rolfe, comp. Sep. 1986 740 p Symposium held in London, England, 14-16 Jul. 1986; sponsored by NASA, ESA, and UK Science and Engineering Research Council
(ESA-SP-263; ISSN-0379-6566; ETN-87-98837) Avail: NTIS HC A99/MF E03

The IUE observations of the solar system and cool stars; novae, hot stars, galactic haloes, and interacting binaries; and the interstellar medium and active galaxies were discussed. Future UV astronomy missions were considered. For individual titles, see N87-19151 through N87-19307. ESA

N87-19151# Observatoire de Besancon (France). **c89**
COMETS
M. C. Festou *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 3-9 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE observations of comets were used to build a data base of spectra of comets in the UV. In comets observed with IUE, water is the dominant species, and CO and CO2 relative abundances are highly variable. The dust/gas production ratio varies by orders of magnitude from one comet to another. Although there appear signs of variability of many kinds in comet spectra, the evidence from the UV observations is that all comets have the same chemical composition and that observed differences are due to evolution/aging processes. But it is likely that comets are very inhomogeneous at a small scale. ESA

N87-19152*# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics and Astronomy.
THE IO TORUS AND THE JOVIAN MAGNETOSPHERE **c91**
P. D. Feldman *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 11-16 (For primary document see N87-19150 11-88)
(Grant NsG-5393)
Avail: NTIS HC A99/MF E03 CSCL 03B

The IUE monitored the physical conditions in the Jovian

magnetospheric system using the in situ Voyager measurements as a basis for comparison. Both the Io plasma torus, observable in emission of S(+), S(++), and S(+3), and the Jovian H2 polar aurorae are accessible to the IUE short wavelength spectrograph. Despite significant short-term variations observed, the electron density and temperature structure of the torus has not changed appreciably in the 7 yr since the Voyager encounters. The total radiated power from the polar aurorae remained relatively constant during this period. ESA

N87-19153# Oxford Univ. (England). Dept. of Theoretical Physics.

CHROMOSPHERES OF COOL STARS **c90**

C. Jordan *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 17-13 (For primary document see N87-19150 11-88)

Avail: NTIS HC A99/MF E03

Progress in understanding the nature and origin of cool star chromospheres and transition regions since the launch of IUE is reviewed. While previous observations in the visible and UV regions laid the foundations for present work, the nature of the IUE instruments and long operating lifetime led to substantial advances. The broad sample of objects obtainable with IUE at low spectral resolution allowed insights into the properties of chromospheres and coronae across the H-R diagram. High resolution spectra are used to model the structure and energy balance in a variety of stars. Trends in line fluxes are being understood in a quantitative manner allowing further insight into heating processes. Insights into the basic spectroscopy and atomic physics of cool giant and supergiant chromospheres are obtained. ESA

N87-19154# Lowell Observatory, Flagstaff, Ariz. Planetary Research Center.

COMETS P/GIACOBINI-ZINNER AND P/HALLEY AT HIGH DISPERSION **c90**

David G. Schleicher and Michael F. AHearn (Maryland Univ., College Park) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 31-33 (For primary document see N87-19150 11-88)

Avail: NTIS HC A99/MF E03

High-dispersion IUE spectra of Comet Halley and Comet Giacobini-Zinner were obtained. Results include a new upper limit for (OD/OH) less than 0.0003 to 0.0005, significant spatial variation in the profiles of the OH bands, and the first cometary continuum seen at high dispersion. The limit on (OD/OH) implies an upper limit of 10 to 20x for the fractionation that occurred during the formation of the comets. The relative strengths of the lines of OH vary with distance from the nucleus in such a way as to show that, near the nucleus, collisions quench the Lambda doublet inversion. Careful fitting of the band profiles will reveal the size of the hole at the nucleus seen by radio astronomers. ESA

N87-19155*# National Aeronautics and Space Administration, Washington, D.C.

ULTRAVIOLET SPECTROPHOTOMETRY OF COMET GIACOBINI-ZINNER DURING THE ICE ENCOUNTER **c90**

Michael F. AHearn (Maryland Univ., College Park), Lucy A. McFadden, Paul D. Feldman (Johns Hopkins Univ., Baltimore, Md.), Hermann Boehnhardt (Remeis Sternwarte, Bamberg, West Germany), Juergen Rahe, Michael Festou (Observatoire de Besancon, France), John C. Brandt (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.), Stephen P. Maran, Malcom B. Niedner, Andrew M. Smith et al *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 35-38 (For primary document see N87-19150 11-88)

(Grants NAG5-252; NsG-5393)

Avail: NTIS HC A99/MF E03 CSCL 03B

The IUE spectrophotometry of Comet P/Giacobini-Zinner was acquired in support of the International Cometary Explorer (ICE) mission. The abundances (or upper limits) of UV-active species were calculated. During the ICE encounter the H2O production rate was 3 times 10 to the 28th power/sec, + or - 50%, consistent with values derived from the ICE experiments. Comparison of the abundance of CO2(+) ions with the total electron density measured by the plasma electron experiment on ICE indicates a deficiency of ions relative to electrons indicating a population of ions not detected by remote sensing. The absence of detectable Mg(+) rules out this species as a possible ion of M/Q = 24 detected by the Ion Composition Instrument, part of the ICE complement of instruments. ESA

N87-19156*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

IUE OBSERVATIONS OF COMET HALLEY: EVOLUTION OF THE UV SPECTRUM BETWEEN SEPTEMBER 1985 AND JUNE 1986 **c90**

P. D. Feldman (Johns Hopkins Univ., Baltimore, Md.), M. C. Festou (Observatoire de Besancon, France), M. F. AHearn (Maryland Univ., College Park), C. Arpigny (Liege Univ., Belgium), P. S. Butterworth, C. B. Cosmovici (Consiglio Nazionale delle Ricerche, Frascati, Italy), A. C. Danks (Michigan State Univ., East Lansing), R. Gilmozzi (European Space Agency. ESA Tracking Station, Madrid, Spain), W. M. Jackson (California Univ., Davis), L. A. McFadden (Maryland Univ., College Park) et al *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 39-42 (For primary document see N87-19150 11-88)

(Grants NsG-5393; NAG5-252)

Avail: NTIS HC A99/MF E03 CSCL 03B

The UV spectrum of comet P/Halley (1982 i) was monitored with the IUE at regular time intervals. A complete characterization of the UV spectrum of the comet was obtained to derive coma abundances and to study the light emission mechanisms of the observed species. The Fine Error Sensor (FES) camera of the IUE was used to investigate the coma brightness variability on short time scales. Spectroscopic observations as well as FES measurements show that the comet nucleus activity was highly variable. ESA

N87-19157# State Univ. of New York, Stony Brook. Dept. of Earth and Space Sciences.

IUE OBSERVATIONS OF SATURN'S RINGS **c91**

R. Wagener and J. J. Caldwell *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of IUV Astronomy with IUE Sep. 1986 p 43-44 (For primary document see N87-19150 11-88)

Avail: NTIS HC A99/MF E03

A 5.5 h SWP exposure completed a set of 12 IUE spectra of Saturn's rings obtained between July 1982 and February 1985. The most obvious feature of the combined spectrum, which covers the wavelength range from 1600 to 3100 A, is the water ice absorption edge between 1650 and 1700 A. Multiple scattering calculations indicate that the rings must contain extremely small particles (0.003 microns) with a scale height larger than the bigger ring particles. Using the Rayleigh scattering approximation, column abundance = 6 times 10 to the 15th power H2O-ice particles/sqcm above any significant amount of bigger particles. There is also evidence for H2O vapor absorption between 1700 and 1800 A. The derived column abundance is N vapor = 3 times 10 to the 14 power/sqcm. ESA

N87-19158# Osservatorio Astrofisico di Arcetri, Florence (Italy).

IUE AND SKYLAB SPECTRA OF SOLAR-TYPE STARS AND OF SPATIALLY-RESOLVED SOLAR REGIONS **c89**

R. Pallavicini, M. Cerruti-Sola, and C. C. Cheng (Naval Research Lab., Washington, D. C.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 45-47 (For primary document see N87-19150 11-88)

Avail: NTIS HC A99/MF E03

Short-wavelength IUE spectra of nearby solar-type stars are compared with high-resolution spatially resolved ultraviolet spectra of individual solar features (quiet region, plage, flare) obtained

with the slit spectrograph on board Skylab. Comparison reveals remarkable similarity between the range of emission fluxes observed in stars of various activity levels and the range of fluxes emitted by individual solar regions. Since the solar features considered differ mainly in the level of magnetic activity, it is likely that the same occurs for stars. The strong similarities between spectra of active stars and spectra of solar plages suggest that active regions cover a much larger fraction of the stellar surface in young rapidly rotating stars. ESA

N87-19159# Institut d'Astrophysique, Paris (France).
SEARCH FOR Be IN FOUR COOL CP STARS **c89**
M. Gerbaldi, R. Faraggiana (Trieste Univ., Italy), and P. Molaro *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 49-52 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

High resolution IUE spectra of four cool CP stars were analyzed to search for the Be II 3130-3131 resonance doublet. No large overabundances similar to those found in Hg-Mn stars are found. Two of the stars analyzed were previously found as Li overabundant, suggesting different behaviors of the two elements. Predictions of Li overabundance and Be underabundance by microscopic diffusion are advanced for stars of two solar masses, but in absence of a magnetic field. ESA

N87-19160# Hawaii Univ., Honolulu. Inst. for Astronomy.
ROTATION-ACTIVITY RELATIONS FOR LATE-TYPE STARS: WHERE DO WE STAND NOW? **c90**
Theodore Simon *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 53-56 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Activity in active chromosphere stars, many of which are single-line RS CVn binaries whose strong UV chromospheric emission lines were observed with IUE is discussed. The UV emission of active chromosphere stars as an undifferentiated class decreases in strength with declining rotation rate, but there is little or no dependence of emission upon rotation for stars within individual luminosity classes. The enhanced activity of the evolved RS CVn binaries is not inconsistent with theoretical predictions of a decrease in the Rossby number NR during evolution away from the main sequence, but there is no direct support for an empirical Rossby-type rotation-activity relation for these stars as found for dwarfs. The short rotation periods of such active stars may place them in a regime of small NR where changes in the pattern of convective motions alter the efficiency of the dynamo and where surface activity depends only weakly, discontinuously, or stochastically on NR. ESA

N87-19161*# Tufts Univ., Medford, Mass. Dept. of Physics and Astronomy.
SIMULTANEOUS IUE AND VLA OBSERVATIONS OF YZ CANIS MINORIS, AD LEONIS AND LAMBDA ANDROMEDAE **c89**
Robert F. Willson and Kenneth R. Lang *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 57-60 (For primary document see N87-19150 11-88)
(Grant NAG5-477; Contract N000-14-86-K-0068; Grant AF-AFOSR-83-0019)
Avail: NTIS HC A99/MF E03 CSCL 03A

The IUE and VLA simultaneously observed the dwarf IM flare stars YZ Canis Minoris and AD Leonis, and the RS CVn star Lambda Andromedae. Narrow-band, slowly varying radiation near 20cm wavelength was detected from YZ Canis Minoris. The radiation cannot be attributed to conventional emission processes, but may be explained by a coherent emission mechanism. The Mg II h and k line intensities also underwent changes in intensity, although the connection between the microwave and ultraviolet variations is unclear. Impulsive microwave bursts were detected from AD Leonis, but there were no significant variations in the Mg II line intensities. Enhancements in several ultraviolet emission lines were detected on timescales of 1 hr from Lambda Andromedae without accompanying variations at 6cm or 20cm wavelength. ESA

N87-19162# Catania Astrophysical Observatory (Italy).
CHROMOSPHERE EMISSION IN LATE MAIN SEQUENCE STARS OF DIFFERENT MASSES AND AGES **c90**
E. Marilli, S. Catalano (Catania Univ., Italy), and C. Trigilio *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 61-64 Sponsored by the Italian Ministero della Publica Istruzione (For primary document see N87-19150 11-88)
(Contract CNR-85-00244-02)
Avail: NTIS HC A99/MF E03

Results on observations of emission components in the H and K lines of Ca II and in the h and k lines of Mg II of main sequence late type stars, belonging to the young Hyades and Coma clusters and the old moving groups, Zeta Her, epsilon Ind, sigma Pup, and Arcturus are presented. An approach to obtain integrated emission fluxes of Mg II lines from IUE low resolution spectra of solar and late type MS stars is proposed. From a preliminary analysis of the Ca II and Mg II emission luminosity, the relation L(chrom) alpha mass upsilon is found to be valid at least for young cluster stars, with upsilon = 4.34 for the Hyades. A probable dependence of the chromospheric emission luminosity from the metallic abundance in the old disk population stars is discussed. ESA

N87-19163*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ULTRAVIOLET LINES OF CARBON, NITROGEN, AND OXYGEN IN THE IUE SPECTRUM OF THE FIELD HORIZONTAL-BRANCH A STAR HD 109995 **c89**
David S. Leckrone and Saul J. Adelman *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 65-69 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

Photospheric abundances of C, N and O of an evolved halo Population 2 star, the field horizontal-branch star HD 109995, based on observations of ultraviolet resonance or low excitation lines are presented. The logarithmic abundance ratio with respect to the Sun [O/Fe] = +1.5 is substantially higher than previously determined values for Pop. 2 red giants or RR Lyrae stars, but agrees well with a derived value from the OI infrared triplet. This may be direct evidence of Tinsley's (1979) scenario of localized sharply rising interstellar oxygen abundances immediately following bursts of massive star formation. Star HD 109995 may have formed from such highly oxygen-enriched material prior to its dilution by gas with the pre-burst composition. The ratio [C/N] = -1.3 may reflect the composition of material from which the star formed or CN processing within the star during its evolution. ESA

N87-19164# Observatorium Hoher List, Bonn (West Germany).
SEARCH FOR CHROMOSPHERIC Mg II EMISSION IN Ap-TYPE STARS **c89**
W. Seggewiss *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 71-74 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The low-dispersion IUE spectra were searched for emission in the Mg II h,k resonance lines of peculiar A-type stars (Ap, Am, Lambda Boo). Spectra show the Mg II h,k lines in absorption. The absence of emission is confirmed by comparison with 53 high-dispersion spectra. High-dispersion spectra reveal no sign of a chromosphere for three Ap stars for which weak X-ray emission is reported. ESA

N87-19165# Bologna Univ. (Italy). Dipt. Astronomia.
EFFECTIVE TEMPERATURE, GRAVITY AND METALLICITY OF POPULATION 2 STARS **c90**
C. Cacciari, M. L. Malagnini (Trieste Univ., Italy), C. Morossi

(Osservatorio Astronomico, Trieste, Italy), and L. Rossi (Consiglio Nazionale delle Ricerche, Frascati, Italy) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronony with IUE Sep. 1986 p 75-78 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The Christensen (1978) and Cacciari (1985) collections of absolute spectral energy distributions of Population 2 stars, based on visual and IUE spectrophotometric data respectively, were compared to Kurucz' (1979) theoretical models, with different metallicity, to test the compatibility of the theoretical prediction with the observed flux distributions. Results referring to three stars having different characteristics are presented. The good agreement of the predicted energy distributions with the observed ones shows that in population synthesis studies, Kurucz models can be validly used to integrate the observed star energy distributions or even to mimic them completely, if they are not available. ESA

N87-19166*# Vanderbilt Univ., Nashville, Tenn.
RAPIDLY ROTATING SINGLE LATE-TYPE GIANTS: NEW FK COMAE STARS? c90
Francis C. Fekel *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 79-81 Sponsored by NASA (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03B

A group of rapidly rotating single late-type giants was found from surveys of chromospherically active stars. These stars have V sin I's ranging from 6 to 46 km/sec, modest ultraviolet emission line fluxes, and strong H alpha absorption lines. Although certainly chromospherically active, their characteristics are much less extreme than those of FK Com and one or two other similar systems. One possible explanation for the newly identified systems is that they have evolved from stars similar to FK Com. The chromospheric activity and rotation of single giant stars like FK Com would be expected to decrease with time as they do in single dwarfs. Alternatively, this newly identified group may have evolved from single rapidly rotating A, or early F stars. ESA

N87-19167*# Maryland Univ., College Park. Astronomy Program.
THE TEMPERATURES OF VERY METAL-POOR SUBDWARFS c90
R. A. Bell *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 83-85 (For primary document see N87-19150 11-88)
(Grants NAG5-589; NSF AST-80-19570)
Avail: NTIS HC A99/MF E03 CSCL 03B

The determination of ages for metal poor globular cluster stars using the relationship between stellar effective temperature and color, in order to transform isochrones from the L, Teff plane to the M(V), color plane is described. Estimates of the effective temperatures of metal-poor field subdwarfs deduced from the ratios of the integrated fluxes to the 12000 A fluxes of the 4 subdwarfs are in good agreement with published results. The stars are fainter than the models in the infrared, but the UV fluxes are in good agreement with model predictions. ESA

N87-19168# Oslo Univ. (Norway). Inst. of Theoretical Astrophysics.
THE UNUSUAL ROTATIONAL MODULATION OF THE UV RADIATION FROM THE SPOTTED FLARE STAR EV LAC c90
B. .N. Andersen, O. Kjeldseth-Moe, and B. R. Pettersen *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 87-90 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The UV line spectrum of the spotted flare star EV Lac in its quiescent state was observed with IUE. The observed rotational modulation of chromospheric UV lines is in antiphase with the photospheric variations in visual light. The visual variation is due to a starspot region located near the pole of the star. The transition region lines (80,000 K less than T less than 200,000 K) show no variation. This may indicate a large extent in altitude of the transition region causing the emitting regions to be visible throughout the rotation. ESA

N87-19169# Colorado Univ., Boulder. Center for Astronomy and Space Astronomy.
UV AND OPTICAL OBSERVATIONS OF AT MICROSCOP 2 c89
T. R. Ayres, O. Elgaroey (Oslo Univ., Norway), and P. Joraas *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 91-94 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The red dwarf binary AT Mic was observed in 1985 by IUE in the UV and optical wavelength regions. In the U-band flares were observed at a rate of 1 per hour. In the UV region surface line fluxes are enhanced compared to those of the quiet Sun and show closer relation to values which are characteristic of very active regions on the Sun. Hot lines (C IV, Si IV) show larger broadening and negative frequency shifts whereas cooler lines (Fe II, Mg II) are less broadened and reveal small negative or positive line shifts. Improved radial velocity determinations of AT Mic are essential for the interpretation of the results. ESA

N87-19170# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Astrofisica Spaziale.
X-RAY, ULTRAVIOLET, OPTICAL, INFRARED AND RADIO SIMULTANEOUS OBSERVATIONS OF RU LUPI c89
F. Giovannelli, A. A. Vittone, C. Rossi (Rome Univ., Italy), I. Nastari, G. S. Bisnovatyi-Kogan (Academy of Sciences, USSR, Moscow), I. M. Golynskaya, V. G. Kurt, T. A. Mizyakina, E. Yu. Shafer, V. M. Shamolin et al *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 95-98 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The T Tauri-type star UP Lupi was observed in X-ray, UV, optical, IR, and radio spectral ranges from 1983 to 1986. Strong variations in different time-scales are detected in all the wavelength regions, in the line intensities, and in continuum. The UV spectrum shows strong similarities with those of other T Tauri-type stars, with the exception of the presence of He II (1640 A) variable emission line. The optical spectrum shows generally lower variations than the UV one. The Balmer and He I lines are quite constant. Strong variations are present in the IR behavior of RU Lupi, in particular P alpha and Br beta are sometimes in emission and others in absorption. ESA

N87-19171*# Colorado Univ., Boulder. Center for Astrophysics and Space Astronomy.
Fe II EMISSION LINE PROFILES IN SPECTRA OF HIGH LUMINOSITY NON-CORONAL STARS c89
Kenneth G. Carpenter *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 99-102 (For primary document see N87-19150 11-88)
(Grant NAG5-797)
Avail: NTIS HC A99/MF E03 CSCL 03A

The results of a program to study the winds of noncoronal late-type giant and supergiant stars with IUE are presented. The primary data for this study are profiles, fluxes, and velocities of the Fe II emission lines which occur throughout the 2200 to 3230 A region of the IUE long wavelength spectrographs. The apparent dependence of the Fe II profiles on stellar luminosity (surface gravity) and intrinsic line strength is discussed. The discovery of significant changes in the Fe II profiles in spectra of Gamma Crucis (M3 III), during the period 1978 to 1985, that suggest a substantial change in its outer atmosphere is noted. ESA

N87-19172*# Colorado Univ., Boulder. Center for Astrophysics and Space Astronomy.
ACTIVITY IN WARM STARS: IUE OBSERVATIONS OF EARLY

F DWARFS **c90**
Frederick M. Walter and Jeffrey L. Linsky *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 103-106 (For primary document see N87-19150 11-88)
(Contract NAS5-26409; Grant NAG5-429)
Avail: NTIS HC A99/MF E03 CSCL 03B

Deep low dispersion, short wavelength IUE observations of 69 F dwarfs were studied by overexposing the long wavelength end of the SWP camera by up to 100 times in order to bring up the weak chromospheric and transition region (TR) emission lines. All but one of the stars observed shows evidence for stellar activity, as defined by the presence of large C II and C IV surface fluxes, with fluxes greater than 100,000 ergs/sqcm/sec. There is no correlation between surface flux and the stellar rotation rate in the early F dwarfs. The TR surface fluxes increase systematically with decreasing B-V color, with no evidence for any decrease in the activity as the convection zones become very small. It is argued that there is a fundamental difference in the atmospheric heating mechanisms between early F dwarfs and solar-like stars. The heating of the TR in the early F dwarfs may be dominated by acoustic heating. ESA

N87-19173# Conselho Nacional de Pesquisas, Rio de Janeiro (Brazil).
SIMULTANEOUS UV-OPTICAL OBSERVATIONS OF ISOLATED T-TAURI STARS: THE V4046 SGR CASE **c89**
R. delaReza, G. Quast, C. A. Torres, M. Mayor (Geneva Observatory, Switzerland), G. Meylan, and F. LlorentedeAndres (Instituto Nacional de Tecnica Aeroespacial, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 107-111 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

It is suggested that a group of a southern T-Tauri stars presented by V 4046 Sgr (HDE 319139), Co-2711363, AS 218, and TW Hya, located relatively far from any known dark or molecular clouds, were formed in very small clouds leaving almost no residuals, instead of having escaped from a cloud as suggested in the past of a similar isolated T-Tauri type star (FK Ser). Star V 4046 Sgr is the only group that is double and that presents a large far infrared residual measured from IRAS. Simultaneous observations of V 4046 Sgr in the UV obtained with the IUE and in the optical range by ground based observations are presented. ESA

N87-19174# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
CHROMOSPHERIC-CORONAL ACTIVITY AT HIGH SATURATED LEVELS **c90**
Osmi Vilhu, James E. Neff, and Frederick M. Walter (Colorado Univ., Boulder) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 113-116 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The Mg II fluxes in cool dwarf stars were calculated by measuring a 4 A passband centered on the Mg II k line in high-resolution IUE spectra, and by calibrating the continuum flux using spectra of narrow-lined stars. These measurements and published data on Mg II, C IV, and X-ray emission are discussed. Qualitative physical interpretations for the upper boundaries (in the flux-color diagrams) are suggested. ESA

N87-19175*# Howard Univ., Washington, D. C. Dept. of Physics and Astronomy.
STARS OF TYPE MS WITH EVIDENCE OF WHITE DWARF COMPANIONS **c89**
Benjamin F. Peery, Jr. *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 117-120 (For primary document see N87-19150 11-88)
(Grants NAGw-545; NAG5-772)
Avail: NTIS HC A99/MF E03 CSCL 03A

A search for white dwarf companions of MS-type stars was conducted, using IUE. The overendowments of these stars in typical S-process nuclides suggest that they, like the Ba II stars, may owe their peculiar compositions to earlier mass transfer. Short-wavelength IUE spectra show striking emission line variability in HD35155, HD61913, and 4 Ori; HD35155 and 4 Ori show evidence of white dwarf companions. ESA

N87-19176# Tuebingen Univ. (West Germany). Inst. fuer Astronomie.
THE OUTER ATMOSPHERES OF FK COMAE STARS **c90**
M. Grewing and L. Bianchi (Osservatorio Astronomico, Turin, Italy) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 121-123 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The FK Comae type stars FK Comae, HD 32918, and UZ Librae were compared, using IUE spectra to determine chromospheric and transition line fluxes which are used to compute the emission and measure temperature distribution in these layers. Relative line intensities reveal electron densities in the range 10 to 100 billion/cc in the region where the Si IV lines are emitted. Combining these results gives the sizes of the chromospheres and transition regions of these stars. The extent to which these stars fit on the rotation-activity correlation found for other late-type stars is discussed. The FK Comae stars group near the upper edge to the region populated by main-sequence stars, or even violate the saturation limit of the linear relations, interpreted by Vilhu (1984) as an indication of complete coverage of the stars' surface by active regions. ESA

N87-19177# National Center for Atmospheric Research, Boulder, Colo. High Altitude Observatory.
ROTATIONAL MODULATION OF THE WIND OF THE PMS STAR AB AUR: NEW OBSERVATIONS IN C IV AND Mg II **c90**
C. Catala, F. Praderie (Observatoire de Paris-Meudon, France), and P. Felenbok *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 125-128 Sponsored by NSF (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Star AB Aur was observed in a monitoring program devoted to short term spectral variability in Herbig premain sequence stars. On a one day time scale, the variability of the Mg II 2795 A line blue edge velocity is confirmed, and that of the C IV 1548 line blue edge velocity established. Since observations cover only 6 days and since the phase coverage is not tight enough, the new data can only support the periodic variability of Vs found in previous work. Periods between 40 and 50 hr are possible. Scenarios for the wind model of AB Aur are discussed. ESA

N87-19178# Oslo Univ. (Norway). Inst. of Theoretical Astrophysics.
EUV LINE EMISSION AS A DIAGNOSTIC OF COOL GIANT STARS **c89**
P. Joraas *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 129-132 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Cool giant and supergiant stars were observed with the IUE satellite. Wavelengths, line widths, and fluxes of emission lines in these spectra are measured, using a least squares Gaussian fitting technique. Hot transition region lines are redshifted by 10 to 20 km/sec relative to cold chromospheric lines. The effect increases with stellar activity. The gas densities in these stellar atmospheres are so low that radiative processes, and in particular resonance fluorescence, are the dominant excitation mechanisms. One important example is the pumping of S I by O I. The effectiveness of this process increases with decreasing gas density. ESA

N87-19179# University Coll., Cardiff (Wales). Dept. of Applied Mathematics and Astronomy.
SULPHUR COMPOUNDS IN COMETS c90
K. S. KrishnaSwamy (Tata Inst. of Fundamental Research, Bombay, India) and M. W. Wallis *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 133-136 Sponsored by UK Science and Engineering Research Council (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The bands of S2 were identified in IUE spectra of several comets covering a wide range in heliocentric distances. It is present in comets Cernis and Bowell at 3.4 AU and in comet Halley even from early December 1985 when it was at 1.5 AU. Its presence in 2900 to 3000 A casts doubts on assessments of dust properties from scattered solar light. Bands of the B-X systems of the SO molecule in IRA-Araki-Alcock in the 2200 to 2400 A region are identified. These bands appear to be present in comets Borrelly, Stephan-Oterma, and Meier. Emissions of S(+) and perhaps SH are evident in the spectra of comet Halley of March 1986. ESA

N87-19180# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
AN EPISODE OF MASS EXPULSIONS FROM THE M-DWARF FLARE STAR EV LACERTAE? c90
C. W. Ambruster, B. R. Pettersen (Oslo Univ., Norway), S. Hawley (Texas Univ., Austin), L. A. Coleman (Arkansas Univ., Fayetteville), and W. H. Sandmann (Harvey Mudd Coll., Claremont, Calif.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 137-140 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

In October 1985, observations of the M-dwarf flare star EV Lacertae were conducted for nine consecutive days with IUE, along with contemporaneous ground-based photometric and spectrophotometric coverage, and two extended pointings by EXOSAT to search for atmospheric anomalies which might help to explain the unusually violent flaring behavior of this star. On the night of 8 October 1985 all measured UV fluxes dropped by a factor 2 for 1.5 hr, apparently the result of a major episode of mass expulsion. The simultaneous Ca K (lambda 3934) and H beta light curves imply that a significant flare took place shortly before the start of the IUE observations on this night. No rotational modulation of the light curve was detected, and the mean Mg II (lamdba 2800) and C IV (lamdba 1550) fluxes are very similar to the values for YZ CMi, from which no superflares are reported. ESA

N87-19181*# Indiana Univ., Bloomington.
SYNTHETIC SPECTRA OF COOL STARS FOR THE WAVELENGTH RANGE 2550-3200 A c89
Joel A. Eaton *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 141-144 (For primary document see N87-19150 11-88)
(Grant NAG5-182)
Avail: NTIS HC A99/MF E03 CSCL 03A

In order to interpret the ultraviolet spectra of cool stars obtained with IUE and to determine the physical conditions in their outer atmospheres, synthetic IUE spectra of stars cooler than the Sun, mainly the Sun and the metal-deficient, carbon-rich CH stars were calculated. Results are encouraging. Synthetic spectra for the Sun over the range 2550 to 3300 A give roughly the observed level of overall emission and relative strengths or various absorption features (Fe II, Mg II, Mg I, and Fe I) although they still require extra sources of continuous opacity longward of 2650 A. Spectra of the CH stars have roughly the correct shape in the ultraviolet continuum for the expected effective temperature, although these models are problematic in that the electron density, hence H(-) opacity, is directly proportional to the Mg-Si-Fe density and the ratio of line to continuum opacity is only slightly affected by changing metallicity. ESA

N87-19182*# Indiana Univ., Bloomington. Dept. of Astronomy.
THE OUTER ATMOSPHERES OF COOL M GIANTS: HIGH-DISPERSION ULTRAVIOLET SPECTRA OF RHO PER, 2 CEN, AND HER c90
Joel A. Eaton and Hollis R. Johnson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 145-148 (For primary document see N87-19150 11-88)
(Grant NAG5-182)
Avail: NTIS HC A99/MF E03 CSCL 03A

Long duration IUE spectra were obtained to extend coverage of cool giants studied in the ultraviolet at high dispersion to M6. The chromospheric spectra of the three stars, which consist of a profusion of Fe II lines and a few lines of Mg II, Mg I, Al II, C II, C I, Cr II, and Fe I, are remarkably similar, both among themselves and with respect to stars of earlier spectral type. These lines present a picture of a warm chromosphere that is static in the average but may be far from uniform in density and ionization. The Mg II emission lines of 2 Cen show 2 unresolved absorption components, the shorter at the velocity of the local interstellar medium. The longer is blueshifted from the star by 12 to 18 km/sec and must be one of very few observed shell lines uncontaminated by interstellar absorption. ESA

N87-19183*# Indiana Univ., Bloomington.
ULTRAVIOLET SPECTRA OF THE N-TYPE CARBON STAR TX PISCIUM c89
Hollis R. Johnson, Donald Luttermoser, John H. Baumert (Computer Sciences Corp., Baltimore, Md.), Francois Querci (Observatoire de Toulouse, France), and Monique Querci *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 149-152 (For primary document see N87-19150 11-88)
(Grant NAG5-182)
Avail: NTIS HC A99/MF E03 CSCL 03A

Nine IUE low resolution spectra of TX Psc, one of the brightest N-type carbon stars, were analyzed. The integrated flux of the Mg II (UV 1) line (blend of h and k) varies by a factor of 7, and the flux of other lines varies similarly and in phase. No variations greater than a factor of 2 occur in the continuous flux. Synthetic spectra from a model chromosphere show surprisingly good agreement with the IUE observations. The enormous influence of the wings of the Mg I resonance line is noted, suggesting it may be a major part of the well-known violet and ultraviolet opacity in cool carbon stars. ESA

N87-19184*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
DOPPLER IMAGING OF ACTIVE REGIONS ON AR LACERTAE c89
J. E. Neff, F. M. Walter (Colorado Univ., Boulder), and M. Rodono (Catania Astrophysical Observatory, Italy) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 153-154 Sponsored by CNR, Max-Planck Inst. and NATO (For primary document see N87-19150 11-88)
(Contract NAS5-26409; Grant NAG5-82)
Avail: NTIS HC A99/MF E03 CSCL 03A

The eclipsing RS CVn system AR Lacertae was observed with IUE in October 1981 and October 1983. The phase coverage provided by the 1983 data is adequate to determine the location and size of two plage-like regions in the atmosphere of the K star using a Doppler imaging analysis of the Mg II k lines. A third epoch data set, consisting of many spectra spaced uniformly throughout a single orbital cycle was obtained in September 1985. Rotational modulation of the SWP line fluxes and an initial look at the Mg II lines reveals clear evidence of discrete chromospheric structures. These include a localized flare on the G star, a chromospherically inactive hemisphere on the G star, and plages on the K star. ESA

N87-19185# Oslo Univ. (Norway). Inst. of Theoretical Astrophysics.
OPTICAL AND ULTRAVIOLET OBSERVATIONS OF A GIANT

STELLAR FLARE ON AD LEO **c89**

B. R. Pettersen, S. L. Hawley (Texas Univ., Austin), and B. N. Andersen (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 157-159 (For primary document see N87-19150 11-88)

Avail: NTIS HC A99/MF E03

A giant stellar flare on the dM4e star AD Leo was observed simultaneously with IUE and ground-based instrumentation. Observations obtained in a 15 min interval around flare maximum are discussed. A continuum flux distribution of flare light is obtained, based on an SWP spectrum and UBVR photometry corrected for the influence of emission lines. A 10 million K free-free distribution describes the optical data well, but the observed ultraviolet flux is at least 1 order of magnitude smaller. No single radiation process describes the time averaged flux distribution. Line broadening is evident in hydrogen Balmer emission lines. The Inglis-Teller formula implies an upper limit of 6 times 10 to the 13th power/cc for the electron density. ESA

N87-19186*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.

WHERE DO FLARES OCCUR IN RS CVN SYSTEMS? ANALYSIS OF THE OCTOBER 3, 1981 FLARE ON V711 TAU = HR 1099 OBSERVED BY IUE **c90**

J. L. Linsky, J. E. Neff, B. D. Gross, T. Simon, A. D. Andrews (Armagh Observatory, Northern Ireland), and M. Rodono (Catania Astrophysical Observatory, Italy) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 161-164 Sponsored by CNR, Max-Planck Inst. and NATO (For primary document see N87-19150 11-88)

(Contract NAS5-26409; Grant NAG5-82)
Avail: NTIS HC A99/MF E03 CSCL 03B

A set of IUE observations of V711 Tau = HR 1099 (K1 IV and G2 V) in which high-resolution spectra with the SWP and LWR cameras were obtained during the luminous flare of October 3, 1981 is discussed. Multigaussian fits to the Mg II k and C IV 1548 A lines are consistent with the flare radial velocity being identical to that of the K star. Thus, the flare probably occurred on the K star. There is no evidence for flows as seen during a flare on UX Ari. The strongest emitters of UV radiation during the flare were the L alpha and Mg II lines, which emitted seven times as much energy as all the transition region lines combined. The peak luminosity of the flare in the UV emission lines is 1.5 times 10 to the 31st power ergs/sec, and the total emission in these lines during the flare was about 4 times 10 to the 35th power ergs. ESA

N87-19187*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ROTATIONAL MODULATION IN IUE SPECTRA OF COOL DWARF CHROMOSPHERES: DATA ANALYSIS AND PERIOD SEARCH TECHNIQUES **c90**

B. Altner (Applied Research Corp., Landover, Md.), A. S. Endal, and K. L. Hallam *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 165-168 (For primary document see N87-19150 11-88)

Avail: NTIS HC A99/MF E03 CSCL 03A

The IUE spectra of bright F-K dwarfs were used to investigate rotational modulation in chromospheric and transition region emission lines, with Stellingwerf's phase dispersion minimization (PDM) technique as the basis of time series analysis. Sampling-related aliases are found to dominate the PDM spectra in these sparsely sampled, irregularly spaced time series. The star chosen to illustrate the techniques is epsilon Eridani, a young, chromospherically active K2 dwarf. Strong indications of a rotation period close to 2.8 days in epsilon Eridani from 2 seasons of observations, with evidence for the persistence in longitude of the active area(s) over several hundred rotation cycles are found. ESA

N87-19188*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.

HIGH DISPERSION IUE OBSERVATIONS OF HYBRID-CHROMOSPHERE STARS **c89**

A. Brown, D. Reimers (Hamburger Sternwarte, West Germany), and J. L. Linsky *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 169-172 (For primary document see N87-19150 11-88)

(Contract NAS5-26409; Grants NAG5-82; DFG-RE-353/6-4)
Avail: NTIS HC A99/MF E03 CSCL 03A

High dispersion, wavelength calibrated IUE spectra of the hybrid-chromosphere stars alpha TrA (K2 IIb-IIa) and upsilon Aql (K3 II) are presented. These observations allow accurate measurement of the wind terminal velocities as seen in the Mg II emission line profiles. The terminal velocities deduced for upsilon Aql and alpha TrA are 110 and 120 km/sec respectively. The terminal velocity for alpha TrA is significantly reduced from the 180 km/sec seen in spectra obtained 2 yr earlier. The intersystem emission lines of C I (1993 A), C II (2325 A), C III (1908 A), O I (1641 A; fluoresced) and Si III (1892 A) are at essentially their rest wavelengths. The upsilon Aql C II intersystem multiplet line fluxes indicate an electron density near 1 billion/cc in their line formation region. Results suggest that the transition region intersystem lines are unlikely to be formed in the high velocity wind seen in the Mg II lines but are certainly formed in a region with significant turbulence. ESA

N87-19189*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.

CHROMOSPHERIC AND TRANSITION REGION STRUCTURE OF THE HERBIG EMISSION STARS HR 5999 AND BN ORI **c90**

A. Brown, H. R. E. TjinaDjie (Amsterdam Univ., Netherlands), and P. S. The *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 173-176 (For primary document see N87-19150 11-88)

(Grant NAG5-82)
Avail: NTIS HC A99/MF E03 CSCL 03B

The IUE spectra of HR 5999 and BN Ori were analyzed, showing strong emission lines of C II, C IV, O I, and Si IV (also Mg II in HR 5999), indicating the presence of chromospheres and transition regions around these high mass premain sequence (PMS) stars. Infrared, optical, and ultraviolet observations show that BN Ori has a spectral type of FO-2 IIIe, a bolometric luminosity of 36 L, age 1.5 million yr, and mass 2 to 2.5 solar mass. As HR 5999 fades, the ratio of total to selective absorption increases indicating the appearance of larger grains or changes in grain alignment. Emission measure distributions are used to investigate the atmospheric structure of the stars. As HR 5999 fades the emission measure distribution rises systematically and the inferred transition region pressures increase. The transition region and chromospheric radiative losses are large and imply input mechanical energy fluxes similar to those of lower mass PMS stars. ESA

N87-19190*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.

ULTRAVIOLET AND OPTICAL VARIABILITY OF RY TAURI **c89**

A. Brown, J. L. Linsky, S. A. Drake (Systems and Applied Sciences Corp., Lanham, Md.), and W. Herbst (Van Vleck Observatory, Middletown, Conn.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 177-179 (For primary document see N87-19150 11-88)

(Contract NAS5-26409; Grant NAG5-82)
Avail: NTIS HC A99/MF E03 CSCL 03A

Ultraviolet and optical observations of the T Tauri star RY Tau were analyzed. They show evidence for strong variability over 1985 to 1986. High dispersion IUE observations of the Mg II emission line profiles show significant changes in the wind of RY Tau, with the wind absorption almost disappearing on 1986 March 20. The behavior of the emission line flux variability when compared to the optical light curve shows evidence for changes

in circumstellar extinction and changes in starspot/plage distribution on the visible hemisphere of the star. ESA

N87-19191# Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.
FLARES AND ACTIVE SECTORS ON YY GEMINORUM c90
S. L. Baliunas, J. C. Raymond, and J. G. Loeser *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 181-183 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE ultraviolet and H beta emission spectra obtained during 1 wk were used to map atmospheric activity on the component stars of YY Gem (dM1e+dM1e, P = 19.5 h) as a function of orbital and rotational phases. Several flares in H beta on both component stars, as well as two flare-like brightenings in the ultraviolet were observed. The behavior of the line ratios of the C II, C IV, and He II features is similar to that of solar surges during the ultraviolet brightenings. The spatial extent of the ultraviolet phenomena is small. In the ultraviolet and visible, certain phases or areas of the stars are apparently more active than others. ESA

N87-19192# Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.
THE SURFACE AND ATMOSPHERIC STRUCTURE OF THE ACTIVE G8 III STAR FF AQUAR 2 c90
S. L. Baliunas, J. G. Loeser, J. C. Raymond, E. F. Guinan (Villanova Univ., Pa.), and J. D. Dorren (Pennsylvania Univ., Philadelphia) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 185-187 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE ultraviolet investigations of the eclipsing binary FF Aquarii (G8 III + sdOB, P = 9.2 d) are discussed. They reveal intense and extreme chromospheric activity in the cool star. The giant star's ultraviolet spectrum can be observed during total eclipse of the subdwarf. Spectra obtained during ingress and egress of the total eclipse show that absorption lines in the subdwarf spectrum, e.g., C II and C IV are doubled in strength relative to quadrature. This excess absorption is likely caused by a geometrically extended atmosphere of the G8III star and the enhancements are present at least to 1.5 stellar radii above the surface of the G8 III star. Since the enhancements persisted for 3 yr they cannot be transient phenomena. ESA

N87-19193# Oxford Univ. (England). Dept. of Theoretical Physics.
THE OUTER ATMOSPHERES OF LATE-TYPE GIANT STARS c90
P. G. Judge *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 189-192 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Results of work with IUE on the structure of the outer atmospheres of late-type giant stars are summarized, based on empirical constraints derived from emission lines in alpha Boo (K2 III), alpha Tau (K5 III), and beta Gru (M5 III), observed with deep exposures in the high resolution mode of IUE. The stars have IUE spectra typical of giant stars on the wind side of the corona-wind division in the HR diagram. The structure of the emitting regions, including densities, temperatures, inhomogeneities, geometric extents, and velocity fields is emphasized. Comparisons are made with earlier chromospheric models and with other spectroscopic work, and trends with stellar parameters are examined. Implications for modeling the winds of red giants are discussed. ESA

N87-19194# STI, Inc., Lanham, Md.
THE STELLAR WINDS OF K AND EARLY M GIANTS: EVIDENCE FOR A SUBCLASS WITH ABNORMALLY HIGH EXPANSION VELOCITIES c90
S. A. Drake *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 193-196 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The morphology of IUE Mg II resonance lines in K and early M giants is presented. Winds of high greater than or = 50 km/sec) velocity are quite common in K giants, particularly of MK Class IIIa, but rare in M giants. In one confirmed case (gamma Phe; K5III) and another probable case (sigma Pup; K5III), the simultaneous presence of C IV emission and a cool, high-velocity wind imply the existence in normal giants of the hybrid-atmosphere phenomenon recognized in G and K bright giants and supergiants. ESA

N87-19195*# Villanova Univ., Pa.
EVIDENCE OF LARGE-SCALE STRUCTURES IN THE ATMOSPHERE OF THE ACTIVE K-DWARF COMPONENT OF V471 TAURI c90
E. F. Guinan, S. W. Wacker, S. L. Baliunas (Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.), J. G. Loeser, and J. C. Raymond *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 197-200 (For primary document see N87-19150 11-88)
(Grants NAG5-382; NAG5-87)
Avail: NTIS HC A99/MF E03 CSCL 03B

Contemporaneous IUE ultraviolet spectra and visible photoelectric data of the eclipsing binary V471 Tauri (K2V + DA) between 1979 and 1985 was analyzed. The combined data detail the three-dimensional structure of atmospheric loops and their associated starspots on the K dwarf. The distribution of starspot regions on the surface of the K star was inferred from the visible photometry. When spots are located near the limb of the K dwarf prior to and shortly after the total eclipse of the white dwarf, absorption lines such as C II, C III, c IV, and Si IV appear superimposed on the continuum of the white dwarf. These absorption lines are likely caused by cool coronal loops overlying the spots in the atmosphere of the K dwarf. The loops can extend nearly one stellar radius above the surface of the K2V star. ESA

N87-19196*# Pennsylvania Univ., Philadelphia. Dept. of Astronomy and Astrophysics.
THE LONG-TERM EVOLUTION OF CHROMOSPHERIC, TRANSITION-REGION, AND STARSPOT ACTIVITY IN THE RS CVN SYSTEM V711 TAURI c90
J. D. Dorren, E. F. Guinan (Villanova Univ., Pa.), and S. W. Wacker *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 201-204 Sponsored by NASA Goddard Space Flight Center (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03B

Using IUE spectra of the RS CVn binary V711 Tau from 1978 to 1984, the emission fluxes of the prominent chromospheric and transition-region lines are examined to trace the long-term development of active regions on the active component of the system. Optical observations reveal a systematic increase in the star's mean brightness, accompanied by an overall decrease in the chromospheric H-alpha emission, while the star becomes bluer. These changes could be related to a general decrease in the photospheric (spot) and chromospheric activity from 1978 to 1984. The UV emission-line fluxes from SWP low dispersion IUE spectra near the light curve extrema show a rise in emission from 1978 to a maximum in 1982 to 1983, followed by a sharper decline to reach the 1978 level by late 1984. Although the behavior of each of these aspects of the star appears to show systematic changes, the relationships among them are complicated. ESA

N87-19197# Computer Sciences Corp., Greenbelt, Md. Astronomy Program.
IUE OBSERVATIONS OF THE ERUPTIVE PRE-MAIN SEQUENCE OBJECT FU ORIONIS c89
Rosalie Ewald, Catherine L. Imhoff, and Mark S. Giampapa *In* ESA Proceedings of an International Symposium on New Insights

in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 205-207 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Two years of IUE observations were used to examine the nature of the eruptive pre-main sequence object FU Orionis. The Mg II emission line is quite strong with a surface flux of 180 million erg/sqcm/sec, and probably arises in a wind and extended envelope. The Mg II h and k line profiles appear to be P Cygni, indicating that a substantial wind persists 50 yr after the original outburst in the star. The ultraviolet spectrum, aside from the Mg II emission, resembles F2 Ia standard star spectra. ESA

N87-19198# Science Research Council, Chilton (England). Space and Astrophysics Div.
A COMPARISON OF FAR-UV SPECTRA OF SOLAR AND STELLAR FLARES c92
K. J. H. Phillips and G. E. Bromage *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 209-212 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE observations of the flare star AT Microscopii while in a flaring state are compared with solar flare observations in a similar wavelength range taken with a slit spectrograph on Skylab. With emission in the UV lines in each case reduced to power (erg s-1), the AT Mic values are between 10**4 and 10**5 times the solar value except for Ly alpha, which is much less. When normalized to the C II 1335 line feature, lines due to Si IV, C IV and He II are significantly more intense in the AT Mic than the solar flare spectra. There is a strong continuum in the stellar spectra, which is compared with that in other IUE flare star and Skylab solar spectra. The continuum intensity is strongly correlated with the C IV 1550 A line intensity, supporting the notion that the continua seen in flare star IUE spectra arise from the heating of the stellar photosphere by UV lines. ESA

N87-19199*# Colorado Univ., Boulder. Center for Astrophysics and Space Astronomy.
Mg II EMISSION FROM SHOCK WAVES IN MIRA VARIABLES c90
Edward W. Brugel, Lee Anne Willson (Iowa State Univ. of Science and Technology, Ames), and Robert Cadmus (Grinnell Coll., Iowa) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 213-216 (For primary document see N87-19150 11-88)
(Contract NAS5-28731; Grant NAG5-350)
Avail: NTIS HC A99/MF E03 CSCL 03B

In order to investigate the atmospheric shock dynamics of Miras, a program to monitor the ultraviolet Mg II flux, the visual magnitude (using the IUE FES-magnitude) and whenever possible the hydrogen Balmer emission for several Miras was initiated. Results suggest that it should be possible to derive the density structure of the atmosphere and hence estimate quite accurately the kinetic energy input into the stellar atmosphere. The atmospheric shock models suggest that at phase equal 1.0 most of the energy which enters the region where the shock is located ends up in the wind. This is after the strongest Mg II emission is seen. From an observed velocity at infinity and an estimate of the energy input derived from the Mg II flux, it will be possible to determine the mass loss rate for these objects. ESA

N87-19200# Boston Univ., Mass.
CHROMOSPHERIC EMISSION IN OPEN CLUSTER RED GIANTS c89
Kenneth A. Janes and Graeme H. Smith (Dominion Astrophysical Observatory, Victoria, British Columbia) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 217-219 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Two red giant stars on the upper giant branch of M67 were observed by IUE. Both of the spectra show Mg II emission, indicative of activity. Ground-based spectra of the Ca II K-line, although only weakly exposed, confirm the chromospheric emission. ESA

N87-19201*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LONG-TERM SPECTROSCOPIC MONITORING OF ALPHA ORIONIS c89
C. Sonneborn, S. L. Baliunas (Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.), A. K. Dupree, E. F. Guinan, and L. Hartmann *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 221-223 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

Ultraviolet spectroscopy (IUE) and optical photometry of Alpha Orionis (M2 Iab) were obtained at 2 wk intervals from January 1984 through April 1986. The ultraviolet (2950 to 3050 A) and optical continua are found to vary in phase with each other. The Mg II h and k total emission flux is similarly modulated, but lags the optical light curve by 0.25 yr. However, the h and k line fluxes vary by different amounts and in a manner which suggests a periodicity of 1 yr. These and other spectral variations may be causally linked to atmospheric disturbances, possibly related to a close stellar companion. ESA

N87-19202# Uppsala Ionospheric Observatory (Sweden).
TZ FORNACIS: AN ECLIPSING CAPPELLA-LIKE SYSTEM OBSERVED WITH THE IUE c89
K. Eriksson, M. Saxner, B. Gustafsson (Stockholm Observatory, Sweden), T. R. Ayres (Colorado Univ., Boulder), J. L. Linsky (Joint Inst. for Lab. Astrophysics, Boulder, Colo.), and J. Andersen (Copenhagen Univ., Denmark) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight years of UV Astronomy with IUE Sep. 1986 p 225-227 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE observed TZ Fornacis at orbital phases 0.0, 0.25 and 0.79 in 1986. Most of the exposures were LWP-HI or SWP-LO. Results show that: the surface fluxes for transition region emission lines are similar to those for the Capella system while that of the Mg II emission is smaller; the total flux in the Mg II emission lines is constant with phase, whereas the flux in the C IV emission lines decreases by 1/3 during primary eclipse, indicating that most of the activity is due to the hotter giant (F7 III), which is also the case for Capella. ESA

N87-19203*# Armagh Observatory (Northern Ireland).
IUE SPECTRA OF FLARES ON AU MIC c90
C. J. Butler, M. Rodono (Catania Astrophysical Observatory, Italy), and J. L. Linsky (Joint Inst. for Lab. Astrophysics, Boulder, Colo.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 229-232 (For primary document see N87-19150 11-88)
(Grants NAG5-82; CNR-82-01382-02; NATO-No-386/84)
Avail: NTIS HC A99/MF E03 CSCL 03B

Some IUE spectra were obtained in August 1980 through a substantial part of the optical cycle of the BY Draconis-type, spotted M dwarf star, AU Mic. No modulation of the ultraviolet emission line fluxes in antiphase with the optical curve is detected. Simultaneous optical photometry of AU Mic shows remarkably poor correlation of optical flare strength and ultraviolet emission-line enhancements. The flares detected on AU Mic show considerable variety in the degree of enhancement in the various emission lines and optical continuum. ESA

N87-19204# Osservatorio Astronomico, Trieste (Italy).
EFFECTS OF INTERSTELLAR ABSORPTIONS ON Mg II CHROMOSPHERIC EMISSIONS c89
G. Vladilo, L. Crivellari, P. Molaro, J. E. Beckman (Consejo Superior Investigaciones Cientificas, Tenerife, Spain), and R. Genova *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 233-236 (For primary document see N87-19150 11-88)

Avail: NTIS HC A99/MF E03

The Mg II chromospheric emissions in cool stars were analyzed using high resolutiion IUE archive spectra. The ways in which interstellar (IS) absorptions can affect the shapes of the chromospheric profiles are discussed. It is possible to indicate regions of the sky where the Mg II IS absorption can be neglected, up to distances of a few tens of parsecs. When the absorption is present, radial velocity can be estimated, to predict the kind of distortion introduced onto the line profile. Once the IS contamination is taken into account, the chromospheric profiles of the stars tend to have a homogeneous behavior. ESA

N87-19205*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
A REVIEW OF THE ULTRAVIOLET STUDIES OF GALACTIC NOVAE **c89**
Sumner Starrfield (Arizona State Univ., Tempe) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 239-245 Sponsored in part by DOE (For primary document see N87-19150 11-88)
(Grants NAG5-481; NSF AST-83-14788; NSF AST-85-16173)
Avail: NTIS HC A99/MF E03 CSCL 03A

The IUE contribution to studies of galactic novae in quiescence and in outburst are reviewed. A class of novae in which the outburst occurs on an ONeMg white dwarf was identified. Ejected masses, elemental abundances, and ultraviolet light curves for a wide variety of nova outbursts were determined. ESA

N87-19206# Technische Univ., Munich (West Germany). Sternwarte.
MASS LOSS OF HOT LUMINOUS STARS **c90**
R. P. Kudritzki, A. Pauldrach, and J. Puls *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 247-258 (For primary document see N87-19150 11-88)
(Contract DFG-Ku-472-11/1)
Avail: NTIS HC A99/MF E03

The concept of radiation driven winds is reviewed with respect to the observed properties of mass-loss in massive OB-stars. It is shown that improvements of radiation driven wind theory lead to a much better agreement with the observations and permit reproduction of the observed values of mass-loss rate and terminal velocities. It is shown that detailed non-LTE multilevel calculations including electron collisions are necessary to describe the ionization excitation of stellar winds properly. The full treatment of the statistical equilibrium for all relevant ions from H to Zn together with the radiation hydrodynamics of cool O-star winds leads to a significant shift to higher ionization stages, caused by collisional excitation of low lying excited levels and subsequent photoionization from these levels. As a result, high ionization species can be easily produced in a cool wind model for Zeta Puppis. Thus the problem of superionization can be solved without any other source of ionization. ESA

N87-19207*# Wisconsin Univ., Madison. Washburn Observatory.
THE GALACTIC CORONA **c90**
Blair D. Savage *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 259-265 (For primary document see N87-19150 11-88)
(Grant NAG5-186)
Avail: NTIS HC A99/MF E03 CSCL 03B

The IUE observations and theories involving the gaseous galactic corona of the Milky Way are reviewed. Observational topics emphasized include results relevant to the z distribution, kinematics, and ionic and elemental abundances of the gas. The theories for the support, ionization, and kinematics of the galactic halo appear to require a merging of the ideas associated with the galactic fountain models and the photoionized halo models. The Si IV found in the galactic halo is likely mostly produced by photoionization while the N V is probably mostly produced by collisional ionization in cooling fountain gas; C IV may represent an intermediate case with important contributions from photoionization and from collisional ionization. ESA

N87-19208# La Plata Univ. (Argentina). Facultad de Ciencias Astronomicas y Geofisicas.
EVOLUTION OF INTERACTING BINARIES **c90**
Jorge Sahade *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 267-274 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE contribution to studies of interacting binary stars is reviewed. Results on high temperature regions, mass loss and streams, mass accretion, and variable, optically thick plasmas are discussed. ESA

N87-19209# European Space Agency. ESA Tracking Station, Madrid (Spain). IUE Observatory.
EIGHT YEARS OF UV OBSERVATIONS OF THE RECURRENT NOVA T CORONAE BOREALIS **c89**
A. Cassatella, R. Gilmozzi, and P. L. Selvelli (Osservatorio Astronomico, Trieste, Italy) *In its* Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 277-278 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The recurrent nova T Cr B was monitored with IUE since 1978. The UV continuum varies significantly in slope and intensity and can be represented by a power law lambda to the power-alpha, where alpha ranges from 0.1 to 1.1. The observed UV luminosities indicate mass transfer rates between 10 to the minus 7th to minus 8th power solar masses per year. The overall behavior of T Cr B can be interpreted in terms of (variable) accretion onto a white dwarf, but the radial velocity data indicate a more massive companion. ESA

N87-19210# Kiel Univ. (West Germany). Inst. fuer Theoretische Physik und Sternwarte.
ANALYSIS OF FAINT BLUE STARS AT HIGH GALACTIC LATITUDES **c89**
U. Heber and G. Langhans *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 279-282 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Ultraviolet and visual spectra of 16 faint B-type stars at high galactic latitudes are analyzed for effective temperature, gravity, and helium abundance by means of model atmospheres. Nine stars are helium poor while six have normal helium abundance; SB 939 is found to be an intermediate helium star; SB 357 appears to be a rapidly rotating Be star; and PHL 346 is probably metal rich. From the (g,Teff)-diagram it is concluded that the helium poor stars are horizontal branch stars. Four of them are sdB stars and belong to the extended horizontal branch. The helium normal stars are main sequence stars with masses between 3 and 8 solar masses, which are far away from the star forming regions in the galactic plane. ESA

N87-19211*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE MASSIVE STAR CONTENT OF BLUE IRREGULAR GALAXIES **c90**
S. A. Lamb, D. A. Hunter (Lowell Observatory, Flagstaff, Ariz.), and J. S. Gallagher, III *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 283-285 (For primary document see N87-19150 11-88)
(Grant NAG5-404)
Avail: NTIS HC A99/MF E03 CSCL 03B

Three regions of recent star formation in blue irregular galaxies were observed with the IUE in the short wavelength, low dispersion mode. The spectra indicate that the massive star content is similar

in 2 of the 3 regions and is best fit by a synthesized spectrum of a burst of massive stars 2.5 to 3.0 million yr old. ESA

N87-19212# Heidelberg Univ. (West Germany). Inst. fuer Theoretische Astrophysik.
WINDS FROM CENTRAL STARS OF PLANETARY NEBULAE **c90**
G. Bombeck, J. Koeppen, and U. Bastian *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 287-290 Sponsored by Deutsche Forschungsgemeinschaft (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The P Cygni line profiles extracted from IUE high dispersion spectra of central stars of planetary nebulae IC 418, 2149, NGC 6826, 6210, 7009, 1535, 3242 are analyzed by profiles calculated with the Sobolev source function for pure scattering. In the winds of most objects the velocity increases rather slowly with radius (Beta = 4). Well observed nebulae show evidence for ionization stratification. The derived column densities of C IV, N IV, N V, O IV, O V, Si IV are correlated with the nebular excitation. This indicates that the ionization in the wind is governed by the stellar photons. The derived mass loss rates are 10 to the minus 7th power solar masses/a, higher than predicted from empirical mass loss formulae for Population 1 stars. ESA

N87-19213*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE TERMINAL VELOCITIES OF WINDS IN CENTRAL STARS OF PLANETARY NEBULAE **c90**
Sara R. Heap *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 291-294 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03B

The theory of radiatively driven stellar winds is applied to the central stars of planetary nebulae, and the predicted relation between escape velocity and terminal velocity of the wind is assessed. Ultraviolet spectra obtained with IUE indicate that the terminal velocities of winds from planetary nuclei, which range from 600 to 3600 km/sec, are strongly correlated with stellar temperature. The theory of radiative winds predicts that the terminal velocity of the wind = T(1.2), the constant of proportionality being a function of stellar mass and line-force parameter, alpha. Given a mass of 0.60 solar mass for central stars with winds, the line-force parameter alpha = 0.70, a value higher than Abbott's predictions, alpha = 0.61 (1982). ESA

N87-19214*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IUE SURVEY OF PLANETARY NEBULAE IN THE LARGE AND SMALL MAGELLANIC CLOUDS **c89**
T. R. Gull, A. G. Michalitsianos, S. P. Maran, T. P. Stecher, L. H. Aller (California Univ., Los Angeles), and C. D. Keyes *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 295-298 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

Twelve planetary nebulae of the 15 surveyed by IUE in the Megellanic Clouds were analyzed. Chemical abundances and other nebular parameters were determined, along with masses for the central stars. The latter are clustered in the range 0.58 to 0.71 solar masses, contrary to preliminary finding for 3 of the stars. This difference is attributed to the adoption of stellar atmosphere models that better represent the emergent flux distributions below the Lyman limit. ESA

N87-19215*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STATUS REPORT ON IUE ATLAS OF PLANETARY NEBULAE AND RELATED OBJECTS **c89**
Walter A. Feibelman, Nancy A. Oliversen (Computer Sciences Corp., Baltimore, Md.), and Joy Nichols-Bohlin *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 299-301 (For primary document see N87-19150 11-88)
(Contract NAS5-28749)
Avail: NTIS HC A99/MF E03 CSCL 03A

Calibrated IUE spectrograms from an Atlas of Planetary Nebulae are shown, and the organization of the Atlas is described. ESA

N87-19216# Rome Univ. (Italy). Ist. Astronomico.
STUDY OF THE ULTRAVIOLET SPECTRUM OF ETA CARINAE **c89**
A. Altamore, G. B. Baratta (Osservatorio Astronomico, Rome, Italy), A. Cassatella (European Space Agency. ESA Tracking Station, Madrid, Spain), L. Rossi (Consiglio Nazionale delle Ricerche, Frascati, Italy), and R. Viotti *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 303-306 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE spectra of Eta Carinae were studied. The UV spectrum is characterized by strong resonance and intercombination lines with a very complex profile, and by a large amount of Fe II lines with P Cygni profile which are responsible for the very uneven UV energy distribution of the star. The IUE observations reveal high ionization species such as N V and He II not previously identified. This suggests the presence in the Eta Carinae wind of high temperature regions which could be associated to the X-ray emission found by the Einstein Satellite. The emission lines present a narrow peak overimposed on a broad, and frequently asymmetric emission, but the relative strength of the narrow and broad components differs from line to line, probably due to opacity effects and to deviations of the wind from the spherical symmetry. Low and high ionization lines coexist in regions of the wind with the same velocity. This suggests the presence of large inhomogeneities in the wind which could explain why in Eta Carinae there are effective mechanisms of dust condensation and of X-ray emission. ESA

N87-19217# Osservatorio Astronomico, Turin (Italy).
IUE OBSERVATIONS OF MASSIVE STARS IN NEARBY GALAXIES **c89**
Luciana Bianchi, Phil Massey (Kitt Peak National Observatory, Tucson, Ariz.), and John Hutchings (Dominion Astrophysical Observatory, Victoria, British Columbia) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 307-309 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Ultraviolet IUE spectra and optical data were obtained for early-type supergiants in M31 and M33. The UV and visible data yield consistent values for the effective temperature, bolometric magnitude, and extinction. The stars are classified as late O to early B. The UV resonance lines have very low outflow velocities compared to galactic stars, and no P Cygni profiles, suggesting that there may be significant differences in mass-loss mechanisms among Local Group galaxies. The UV interstellar extinction in both galaxies appears like the Large Magallenic Cloud and not like the Galaxy. ESA

N87-19218# Institut d'Astrophysique, Paris (France).
STAR 40 CNC: A VEGA ANALOG? **c90**
Michele Gerbaldi and Rubens Freire-Ferrero (Observatoire de Strasbourg, France) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 311-314 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

High resolution IUE spectra of the blue straggler star 40 Cnc are compared with Vega. Star 40 Cnc behaves in a similar manner, but with a slight overabundance of Si, C and Mq. ESA

N87-19219# Observatoire de Strasbourg (France).
SPECTRUM SYNTHESIS OF UV Ga II AND Ga III LINES COMPARED TO IUE OBSERVATIONS OF HD 25823 AND HD 17081 **c89**
R. Freire-Ferrero and M. C. Artu (Observatoire de Paris-Meudon, France) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 315-318 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The exceptional overabundance of gallium in the magnetic silicon star HD 25823 was studied using the strongest UV Ga II and Ga III lines in IUE spectra. Atomic data were collected to perform an LTE synthetic calculation of the spectral ranges 1406 to 1422, 1487 to 1503, and 1525 to 1542 A. Comparison with the IUE high resolution spectra of the normal star HD 17081 (Pi Ceti) and those of the Ap star HD 25823, confirms previous evaluation of the Ga overabundance (Ga/H= 3000 times solar value) and the Si abundance of 10 times solar value. The Ga anomaly, which is common in Hg-Mn stars but exceptional in Ap-Si stars, is a challenge to the diffusion theory in Ap stars. ESA

N87-19220# Observatoire de Strasbourg (France).
THE INTERSTELLAR ABSORPTION IN THE DIRECTION OF HD 119921 **c90**
R. Freire-Ferrero and R. Ferlet (Institut d'Astrophysique, Paris, France) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 319-322 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Interstellar (IS) absorption in the direction of 2 Cen is analyzed, and the origin of the IS high ionized species Si IV and C IV is discussed, using IUE data. Lines C IV and Si IV are detected at high velocity with a column density ratio of 4. These ions could be formed in a passing shock front from a local supernova remnant responsible for the North Polar Spur of Loop I. ESA

N87-19221# Royal Observatory, Edinburgh (Scotland).
THE EXCITING STARS OF VERY LOW EXCITATION COMPACT NEBULAE IN THE LMC **c90**
K. Nandy, D. H. Morgan, and A. J. Willis (University Coll., London, England) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 323-325 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Ultraviolet spectra of the stars exciting two very low excitation compact nebulae in the Large Magellanic Cloud were obtained with the IUE. The ultraviolet colors match those of lightly reddened B2-B3 stars of luminosity classes III-V. There is little evidence of extensive mass loss sufficient to form the surrounding nebulae. It is found that the very low excitation nebulae do not form a homogeneous class of object. ESA

N87-19222# Vrije Universiteit, Brussels (Belgium). Inst. of Astrophysics.
THE IONIZATION FRACTION OF C IV IN OB STARS **c90**
Ronny Blomme *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 327-330 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The combination of the IUE UV P Cygni line profile of C IV and the IR excess of OB stars was used to determine the mass loss rate and the mean ionization fraction of C IV. The values are very dependent on the velocity parameter Beta. Assuming Beta = 4, the mass loss rate and ionization fraction are fitted against stellar parameters. If the theory of radiatively driven winds is correct, large differences must exist between the velocity laws of different stars. ESA

N87-19223# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Astrofisica Spaziale.
MASS LOSS PROBLEMS IN CYG OB2 ASSOCIATION: THE PARTICULAR CASE OF NO. 8A STAR **c90**
F. Giovannelli, V. F. Polcaro, C. Bartolini (Bologna Univ., Italy), A. Guarnieri, and A. Piccioni *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 331-333 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Analysis of IUE low resolution spectra spread over 3 yr, together with medium dispersion optical spectra from a 152 cm telescope of Cyq OB2 N.8A star are discussed. Data show clear strong anticorrelations in the P Cyg profiles of C IV and Si IV resonance lines, and Balmer lines in absorption. The terminal velocity is extremely high. ESA

N87-19224# University Coll., London (England). Dept. of Physics and Astronomy.
GROSS ULTRAVIOLET SPECTRAL VARIABILITY IN HD 45166 (qWR + B8V) **c89**
Allan J. Willis and David J. Stickland (Science Research Council, Chilton, England) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 335-338 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

High resolution IUE SWP spectra of HD 45166 were secured at various epochs over 1980 to 1983. Data confirm dramatic variations in the qWR P-Cygni profiles and emission lines reported by Willis and Stickland (1983), and reveal large changes also in the qWR highly ionized photospheric absorption spectrum. No changes are apparent in the UV-optical continuum. A common physical origin for the qWR photospheric and stellar wind changes, which may be linked to variations in the ionizing EUV flux into both stellar regions, is suggested. ESA

N87-19225# University Coll., London (England). Dept. of Physics and Astronomy.
HIGH RESOLUTION IUE OBSERVATIONS OF HD 62910 WN6-C4 **c89**
Allan J. Willis and David J. Stickland (Science Research Council, Chilton, England) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 339-342 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

High resolution IUE (SWP+LWR) spectra of the Wolf-Rayet (WN6-C4) star HD 62910, the brightest of the 3 WN-C stars known in the Galaxy are presented. The measured velocity widths of the WN and WC emission lines and P-Cygni profiles show a well-defined, single correlation with transition IP indicating that both sets of lines are formed in the same wind which has a WN6-life v of 2200 km/sec. Data strongly indicate that HD 62910 is a single star showing both WN6 and WC4 spectral features and is at the brief intermediate stage between a WNE and a WC star. The evolutionary implications of this result are discussed. ESA

N87-19226# University Coll., London (England). Dept. of Physics and Astronomy.
THE STELLAR WINDS OF EARLY-TYPE STARS IN THE SMC **c90**
Raman K. Prinja *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 343-346 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Stellar winds of OB stars in the Small Magellanic Cloud (SMC) were studied using low resolution IUE spectra. The UV resonance lines in over 70 stars are examined for the effects of mass-loss. Well developed P Cygni doublets, observed in 21 stars, are fitted using model profiles, allowing for the IUE low resolution instrumental profile. Characteristics of mass-loss in these stars are derived,

including edge velocities and stellar wind densities. Results are compared with the observed properties of winds in Galactic stars of similar spectral type and luminosity. The terminal velocities and wind column densities are usually a factor less than or = 2 lower in the SMC stars; however the products of mass-loss rate and ionization fraction do not differ substantially from those observed in corresponding Galactic O stars. Conclusions about the mass-loss rates are severely limited by uncertainties in the ion fractions and stellar abundances. ESA

N87-19227# Queens Univ., Belfast (Northern Ireland). Dept. of Pure and Applied Physics.
A COMPARISON OF MODELS WITH OBSERVATIONS FOR DISCRETE ABSORPTION COMPONENTS IN SPECTRA OF MASS LOSING STARS c90
B. Bates, D. Halliwell, and M. Catney *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 347-351 Sponsored by UK Science and Engineering Research Council, and Northern Ireland Dept. of Education (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

A model of ejection of gas parcels from above a star's photosphere, accelerated by radiation pressure, is considered in terms of available IUE observations of Mg II lines and recent H alpha profiles obtained for Beta Ori. The model is consistent with the observations for this star and with properties of discrete absorption components (DAC) detected in early type stars. However, the data are not sufficient for rigorous testing of DAC models since the observations are too sparse and not suitably spaced in time. ESA

N87-19228*# Washington Univ., Seattle. Dept. of Astronomy.
DOPPLER TOMOGRAPHY OF THE STELLAR WIND OF THE WOLF-RAYET BINARY STAR V444 CYGNI c89
Douglas N. Brown and Steven N. Shore (New Mexico Inst. of Mining and Technology, Socorro) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 353-356 (For primary document see N87-19150 11-88)
(Grant NAG5-357)
Avail: NTIS HC A99/MF E03 CSCL 03A

High dispersion IUE observations of V444 Cyg around its orbit, emphasizing the C IV, N V, N IV, and He II profile variations are presented. The density and velocity structure of the wind, and details of the interaction between the O star and WR wind are discussed. Absorption becomes strongest and most nearly symmetric during primary eclipse, when the line of sight passes through the densest and most sluggish part of the wind. As the orbit progresses through quadrature, the terminal velocity does not change substantially, although the line of sight to the O star intersects more distant portions of the wind at lower velocity, indicating that there is still a considerable absorption in the line being seen toward the WR core. At secondary minimum, the core is partially occulted and the presence of the cavity eliminates the absorption component, while at third quadrature, a profile almost identical in appearance to that at first quadrature is observed.ESA

N87-19229# New Mexico Inst. of Mining and Technology, Socorro. Astrophysics Research Center.
IUE OBSERVATIONS OF THE HENIZE-CARLSON SAMPLE OF PECULIAR EMISSION LINE SUPERGIANTS: THE GALACTIC ANALOGS OF THE MAGELLANIC ZOO c89
Steven N. Shore, Douglas N. Brown (Washington Univ., Seattle), and N. Sanduleak (Case Western Reserve Univ., Cleveland, Ohio) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 357-360 Sponsored by NASA (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Some 15 stars from the Carlson-Henize survey of southern peculiar emission line stars were studied. From both the optical and UV spectra, they appear to be galactic counterparts of the most extreme early-type emission line supergiants of the Magellanic Clouds. ESA

N87-19230*# New Mexico Inst. of Mining and Technology, Socorro. Dept. of Physics.
IUE OBSERVATIONS OF MAGNETICALLY CONTROLLED STELLAR WINDS IN THE HELIUM PECULIAR STARS c90
Steven N. Shore and Douglas N. Brown (Washington Univ., Seattle) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 361-364 (For primary document see N87-19150 11-88)
(Grants NAG5-179; NAG5-357)
Avail: NTIS HC A99/MF E03 CSCL 03B

Dramatic periodic variations in the C IV resonance lines of magnetic helium-weak sn stars HD 5737 = alpha Scl, HD 21699 = HR 1063, and HD 79158 = 36 Lyn are discussed. In all three cases, the 1548,50 doublet is the only non-negligibly variable UV spectral feature. The line profiles are consistent with outflow in a jet-like structure. In HD 21699 this outflow arises from one of the magnetic polar regions. Observations of two additional He-wk sn stars do not reveal strong C IV absorption, implying that the UV characteristics of these stars are less uniform than the optical phenomenology. ESA

N87-19231*# Washington Univ., Seattle. Dept. of Astronomy.
A LAMBDA 1400 SPECTROPHOTOMETRIC CENSUS OF THE ORION BELT REGION c89
Douglas N. Brown and Steven N. Shore (New Mexico Inst. of Mining and Technology, Socorro) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 365-368 (For primary document see N87-19150 11-88)
(Grants NAG5-179; NAG5-357)
Avail: NTIS HC A99/MF E03 CSCL 03A

Low dispersion IUE spectrophotometry were used to generate a pair of photometric indices which measure the strength of the broad continuum absorption feature at 1400 A, likely an autoionizing transition of Si II. Calibration of the indices as identifiers of silicon overabundance is based on measurements of 25 IUE spectral standards and a sample of O8-A0 IV-V stars, 18 of them silicon stars. The correlations of delta alpha 1400 with delta alpha 5200 and delta (VI-G) support the association of the lambda 5200 feature with silicon. Using this technique, a magnitude limited survey of 28 B-stars in sub-groups b1, b2 and b3 of the Orion OB1 association was conducted. Two previously unrecognized candidate (perhaps weakly overabundant) silicon stars, HD 37187 and BD - 0 deg 984 are identified. ESA

N87-19232# Kiel Univ. (West Germany). Inst. fuer Theoretische Physik und Sternwarte.
ULTRAVIOLET SPECTROSCOPY OF THE HYDROGEN-DEFICIENT STAR HD 144941: THE ENERGY DISTRIBUTION AND THE STELLAR WIND c89
C. S. Jeffrey, U. Heber, and W.-R. Haman *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 369-372 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Low and high resolution ultraviolet spectra of the hydrogen-deficient star HD144941 were obtained using IUE. The energy distribution was compared with model atmospheres and found to be consistent with the effective temperature determined from the ionization equilibrium, but a UV excess is present below 1600A. A departure from the normal Galactic reddening law provides the most likely explanation. Absorption lines formed in an expanding envelope were modelled in the comoving frame. These yield a mass-loss rate in the range -1.1 to the minus 9th power less than M/solar mass/yr less than -2.1 to the minus 10th power. This normal mass-loss rate fails to account for the observed hydrogen-deficiency. ESA

N87-19233# Tuebingen Univ. (West Germany). Inst. fuer Astronomie.

OBSERVATIONAL CONSTRAINTS ON THE ORIGIN AND EVOLUTION OF PLANETARY NEBULAE NUCLEI FROM IUE DATA **c89**

M. Grewing, L. Bianchi, and S. Cerrato *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 373-376 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Low and high resolution IUE spectra were used to determine the temperature and luminosity of the central stars of planetary nebulae and to establish the presence and properties of a stellar wind. Combining these data and data on the properties of the nebula shells, obtained from IUE, and optical and radio observations, with results from stellar evolution calculations, theories of planetary nebulae formation and evolution can be tested. Results for the nuclei of NGC 40 and NGC 6543 are reported. Both are found to have surface temperatures in the range 80,000 to 100,000 K. ESA

N87-19234*# State Univ. of New York, Stony Brook. Astronomy Program.
CARBON AND NITROGEN IN B2 TO A2 MAIN-SEQUENCE STARS **c90**

Johannes Hardorp (State Univ. of New York, Stony Brook), Henryk Cugier, Anuradha Koratkar, and James Scott *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 377-380 (For primary document see N87-19150 11-88)
(Grant NAG5-555)
Avail: NTIS HC A99/MF E03 CSCL 03B

Carbon abundances are derived from the C II resonance doublet at 1335 A in 108 main-sequence stars between 9000 and 21000 K from IUE archival data. Only alpha Leo and psi sq 2 Aqr are strongly carbon deficient (factors 14 and 50, resp.). The N I lines at 1493 and 1495 A were measured in 28 sharp-lined stars below 16500 K. Nitrogen anomalies are found in 5 stars, but seem uncorrelated to the C abundances. Four mechanisms for the depletion of carbon are discussed, but none is satisfactory. ESA

N87-19235# Observatoire de Paris (France).
THE CIV RESONANCE LINES IN Be STARS: THEIR VARIABILITY, THEIR DISAPPEARANCES, AND THEIR ASSOCIATION WITH BALMER EMISSION-LINE VARIABILITY **c89**

V. Doazan and R. N. Thomas (Radiophysics, Inc., Boulder, Colo.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 381-383 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

More than eight years of IUE observations of Be stars were analyzed. Results show that variability is an outstanding property of the far UV spectrum of Be stars. This variability is best seen in the C IV resonance lines which show: remarkable changes in profile and velocity, as well as in the presence, location, and strength of narrow absorption components; large variations in strength going from strong to undetectable lines; and variability patterns associated with those exhibited by the Balmer emission lines. ESA

N87-19236# California Univ., Los Angeles. Dept. of Astronomy.
A STUDY OF THE P-CYGNI LINES IN THE ULTRAVIOLET SPECTRUM OF BETA LYRAE **c89**

Paolo A. Mazzali *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 385-387 Sponsored by NASA (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The properties of the mass loss from the nondegenerate interacting binary system of beta Lyrae are investigated by analyzing the P-Cygni line profiles in the UV spectrum and considering these to be emitted in the wind outflow from the B8II primary component. Observed UV lines obtained by IUE are compared with theoretical models obtained using Sobolev's approximation. The models give satisfactory fittings. Simultaneous fitting of the resonance lines of Al II (1670 A) and Al III (1863 A) show that if the lines are emitted in the same region of the outflowing shell, as the line widths indicate, the electron temperature in the region is 23,500 K, and the mass loss is 2 times 10 to the minus 7th power solar masses/yr. ESA

N87-19237# University Coll., London (England). Dept. of Physics and Astronomy.
SEARCH FOR LINE PROFILE VARIABILITY IN HD 96548 (WN 8+?) AND HD 93131 (WN7ABS) **c89**

L. J. Smith, A. J. Willis, C. D. Garmany (Colorado Univ., Boulder), and P. S. Conti *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 389-392 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

A set of IUE observations was secured in 1985/86 to search for variability in 2 WR stars. The first star, HD 96548 (WN8+?) is a WR+compact candidate (p-4.76d). The SiRV absorption edge gradually decreases by 400 km/sec over the 5 day 1985 observing period. This new dataset alone, and combined with other epochs (1979 to 1982, 1983, and 1986) shows that the SiRV variations do not have the required phase dependence to be caused by the Hatchett and McCray effect. It is concluded that the UV variations are not due to a compact companion and are instead intrinsic to the WR star. The second star HD 93131 (WN7abs) is believed to be single; the IUE data show that it has a constant stellar wind over at least the 5 day observing period, and probably much longer, since 1978 to 1981 archive data are consistent with the 1985 observations. ESA

N87-19238# Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Astronomia.
NARROW ABSORPTION COMPONENTS IN THE IUE SPECTRUM OF THE WN6 SYSTEM HD 193077 **c89**

Gloria Koenigsberger *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 393-394 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Narrow absorption features in the IUE high dispersion spectrum of the Wolf-Rayet system HD 193077 are identified. Components in the resonance lines of Si IV, C IV, Al III, Si II, and C II at -44 km/sec with respect to the undisplaced lines are detected. In addition Si IV and C IV present components at -1250 km/sec. ESA

N87-19239# Indiana Univ., Indianapolis.
DISCOVERY OF A WHITE DWARF COMPANION TO THE MS STAR 4 o(SUP)1 ORI **c89**

Hollis R. Johnson and Thomas B. Ake *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 395-397 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

While investigating the ultraviolet spectra of S stars, a hot compact companion to the MS star 4 o1 Ori was discovered. Fitting the continuum and L alpha profile to models and IUE observations of other white dwarfs, it is shown to be a DA3 star with Teff = 22,000 K. Assuming a luminosity equal to the field DA stars, M = -0.7 for the primary, somewhat fainter than M = -1.2 to -1.4 from other calibrations. In most respects, o sup 1 Ori is an ordinary MS star, with typical values for the Ti/Zr, Li/Ca and Ti isotope ratios. One outstanding difference is the presence of Tc, which is not found in other non-Mira MS and S stars, but the secondary is not likely to be the source. Upper detection limits for hot companions to other bright MS stars are derived: HR 363, RS Cnc, ST Her and OP Her. The nondetection of evolved companions for these stars is consistent with the statistics of field giant binaries. ESA

N87-19240# Arizona Univ., Tucson. Lunar and Planetary Lab.
EFFECTIVE TEMPERATURES OF HOT WHITE DWARFS FROM IUE LYMAN ALPHA PROFILES **c90**
J. B. Holberg and F. Wesemael (Montreal Univ., Quebe) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 399-402 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Lyman alpha profiles of 12 DA white dwarfs free from geocoronal contamination were obtained. Analysis of the profiles provides a uniform, and relatively biasfree measure of effective temperature for the stars over the range 20,000 to 60,000 K. The temperatures are in good agreement with, and in many cases represent a substantial improvement over, ground based determinations. Simultaneous estimates of surface gravity yield a mean result of log g = 7.96 for the entire sample, with the hottest stars tending to have the lowest gravities. A significant exception to this trend occurs in the case of the gravitation of HZ 43. A by-product is the determination of a correction to IUE fluxes over the 1150 to 1350 range. ESA

N87-19241*# Computer Sciences Corp., Greenbelt, Md.
THE LUMINOSITIES OF THE BINARY CEPHEIDS SU CYG, SU CAS AND W SGR **c90**
Nancy Remage Evans and Armando Arellano Ferro *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 403-404 Sponsored in part by a Helm Travel Grant, and the Canadian National Science and Engineering Research Council (For primary document see N87-19150 11-88)
(Contract NAS5-28749)
Avail: NTIS HC A99/MF E03 CSCL 03B

Absolute magnitudes for binary classical Cepheids were derived by ratioing IUE low dispersion spectra in regions where the blue companion dominates with spectra of main sequence spectral type standards. The IUE spectra are also used to determine the magnitude difference between the Cepheid and the blue companion. Absolute magnitudes determined for SU Cyg and W Sgr agree with the absolute magnitudes of Sandage and Tammann and Caldwell within the + or - 0m2 estimated uncertainty, but not with the fainter absolute magnitudes of Schmidt. The absolute magnitude of SU Cas is in better agreement with the PLC relations if it is pulsating in the first overtone mode. ESA

N87-19242*# Computer Sciences Corp., Greenbelt, Md.
THE MASS OF THE CLASSICAL CEPHEID SU CYGNI **c90**
Nancy Remage Evans and C. Thomas Bolton (Toronto Univ., Downsview, Ontario) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 405-407 Sponsored in part by a Helm Travel Grant, and the Canadian National Science and Engineering Research Council (For primary document see N87-19150 11-88)
(Contract NAS5-28749)
Avail: NTIS HC A99/MF E03 CSCL 03B

Radial velocity differences between the classical Cepheid SU Cyg and a hot companion were measured from IUE high dispersion spectra. The blue star is itself a close binary. The triple system solution provides the mass ratio of the Cepheid to the masses of the pair of companions. The masses of the companions are inferred from the low dispersion IUE spectra. The mass derived for the Cepheid is 6.3 solar masses, with a range from 7.0 to 5.9 solar masses, which is very close to the evolutionary mass. ESA

N87-19243# Michigan Univ., Dearborn.
AN ANALYSIS OF THE ULTRAVIOLET SPECTRUM OF HD 101065 BY LINE COINCIDENCE STATISTICS **c89**
D. J. Bord and R. D. Desko (Kansas Univ., Lawrence) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 409-413 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Element identifications in the long wavelength IUE spectrum of HD 101065 (Przybylski's star) using wavelength coincidence statistics are reported. The definite presence of the common iron-peak elements, in addition to numerous doubly ionized rare-earth species, is confirmed. Radial velocity sweeps yield no strong evidence of segregation between the iron-peak and lanthanide rare-earth elements. Evidence to support the identification of Co I and Co II is also presented. The similarity between HD 101065 and several hot, magnetic Ap stars which also exhibit an unusually strong presence of cobalt relative to iron is noted. ESA

N87-19244# Comision Nacional de Investigacion del Espacio, Madrid. Grupos Cientificos.
BLUE STRAGGLER STARS IN THE ULTRAVIOLET **c90**
C. Morales Duran and L. Sabau Graziati *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 415-417 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The spectra of 27 blue straggler stars from galactic clusters and from the field, observed between 1150 and 3200 A, with the IUE are compared with data of normal stars of similar temperatures. Results show in all the A type stars an absorption in the region 1200 to 2000 A similar to that existing in Ap(Si) stars. ESA

N87-19245*# Computer Sciences Corp., Beltsville, Md. Astronomy Program.
THE EVIDENCE FOR ASPECT DEPENDENT WINDS IN Be STARS **c90**
Carol A. Grady, Karen C. Bjorkman (Colorado Univ., Boulder), and Theodore P. Snow *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 419-422 (For primary document see N87-19150 11-88)
(Contract NAS5-25774; Grant NsG-5300)
Avail: NTIS HC A99/MF E03 CSCL 03B

A stellar wind survey in 62 Be and 43 B stars covering 80 III-V to B5 III-V is presented. It is found that the wind absorption seen in C IV in Be stars is due to blended absorption from multiple shortward-shifted discrete components. Such components are not observed in normal B stars, but occur in 63% of the Be stars in the sample. Shortward-shifted discrete components in Be stars are observed only if v sin i is greater than 150 km/sec. Ten Be stars in the sample, including two low v sin i stars, show strong unshifted absorption components, similar to features seen in Beta Cep stars. ESA

N87-19246*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE ENERGY DISTRIBUTIONS OF B SUPERGIANTS IN THE LARGE MAGELLANIC CLOUD **c90**
Edward L. Fitzpatrick *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 423-426 Sponsored in part by NASA and NSF (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

It is shown that line-blanketed, LTE, plane-parallel model atmosphere calculations provide excellent fits to the ultraviolet-through-visual energy distributions of B supergiants in the Large Magellanic Cloud. The models were computed using Kurucz's (1979) ATLAS atmosphere program, but with lower gravities than were contained in Kurucz's published model grid. The ultraviolet continua of low gravity stars are found to be sensitive to changes in temperature and gravity. Measurements of Teff and log g for ten LMC B supergiants from model atmosphere fits to the energy distributions yield estimates of their radii, luminosities, and masses. Model atmosphere fits suggest that the late B supergiants have significantly lower masses than the earlier B types of the same luminosity, contrary to stellar evolution theory which predicts that B supergiants are in a post-core hydrogen burning phase and should evolve very quickly and at essentially constant mass. ESA

N87-19247# European Space Agency. ESA Tracking Station, Madrid (Spain). IUE Observatory.
A-TYPE SUPERGIANTS OBSERVED WITH IUE **c89**
A. Talavera and A. I. GomezdeCastro *In its* Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 427-431 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

A study of the A-supergiants observed with IUE is summarized. Results show that at high resolution they can be divided into two groups: stars which show evidence of wind and mass-loss, and stars which do not show these characteristics. In the first group the resonance lines of Mg II, Fe II, Si II, C II are asymmetric, showing variable blueshifted components. In the second group, formed by the faintest stars, these lines are symmetric. The reported variability suggests a nonstationary structure in the wind of the most luminous A-type supergiants. ESA

N87-19248# University Coll., London (England). Dept. of Physics and Astronomy.
REDSHIFT EVOLUTION OF INTERGALACTIC ABSORPTION CLOUDS **c90**
P. T. OBrien, P. M. Gondhalekar, and R. Wilson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 435-438 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The ultraviolet continuum energy distributions of a large sample of quasars, covering a wide redshift and luminosity range were analyzed, using IUE data. The continuum below Lyman alpha is steeper than that above, and the amount of steepening increases with redshift. The steepening at low redshifts is consistent with models for the ultraviolet spectrum. At higher redshifts, explanations in terms of intrinsic absorption, or reddening from a variety of sources seem unlikely, but the steepening is consistent with absorption due to intervening clouds. The data support evolution in the number density of absorbers with redshift at the 3 sigma level. ESA

N87-19249# Imad ad Dean, Inc., Bethesda, Md.
EMERGING PICTURE OF ACCRETION SHOCKS IN DETACHED BINARIES **c90**
Imad A. Ahmad and Robert D. Chapman (Executive Office of the President, Washington, D. C.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 439-442 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Results of an IUE study of the N V lines in detached binary systems, including evidence for a reverse P-Cygni profile in zeta Aur and 22 Vul are presented. Differences in observable parameters among the systems are examined, and it is suggested how the physical parameters may relate to the observables through their effect on the severity of the shock. ESA

N87-19250*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE R AQUARII-JET AT UV AND RADIO WAVELENGTHS **c90**
A. G. Michalitsianos, M. Kafatos, and J. M. Hollis *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 443-446 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03B

The jet and central star of the peculiar symbiotic variable R Aquarii was monitored with IUE low resolution SWP 1200 to 2000 A spectra, in order to detect possible temporal variations. The absolute line intensities of N V, C IV and He II, as well as numerous other ionic species in the jet are found to vary on a timescale of 1.5 yr. High spatial resolution radio VLA maps and SiO maser millimeter interferometer observations of the star are quoted. ESA

N87-19251# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Astronomy.
IUE CAPABILITIES AND A NEW APPROACH TO SYMBIOTIC STARS **c89**
H. Nussbaumer *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 447-450 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

It is suggested that the nebular emission in symbiotic stars need not to originate around the hot compact object, but that it may be formed close to the cool star due to the radiative action of the hot star. The model is based on IUE observations between 1979 and 1986 of the periodically variable symbiotic star HBV 475. However, its implications extend beyond this individual object. An outbreak of a symbiotic star may be due to a rapid increase in the stellar wind from the cool star. ESA

N87-19252# Milan Univ. (Italy). Dept. of Physics.
FAR UV OBSERVATIONS OF LMC X-3, AN X-RAY BINARY CONTAINING A BLACK HOLE **c89**
A. Treves, T. Belloni, L. Chiappetti (Consiglio Nazionale delle Ricerche, Milan, Italy), S. Cristiani (European Southern Observatory, La Silla, Chile), R. Falomo (Osservatorio Astronomico, Padova, Italy), L. Maraschi, E. G. Tanzi (Consiglio Nazionale delle Ricerche, Milan, Italy), and M. vanderKlis (European Space Agency, European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 451-453 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The X ray source LMC X-3 was observed by IUE at 1200 to 3000 A. Little contribution to the UV flux from the disk is found. Such a contribution shows up in the optical, when the object is in a high state, and should be significant even in the low state if the reddening is small. The UBV photometry shows this contribution. Results demonstrate the observability of the source with IUE and show the need of simultaneous observations over the whole UV-optical range. ESA

N87-19253# Rome Univ. (Italy). Ist. Astronomico.
ULTRAVIOLET BEHAVIOR OF SS CYGNI IN QUIESCENCE AND IN OUTBURST **c90**
S. Gaudenzi, F. Giovannelli (Consiglio Nazionale delle Ricerche, Frascati, Italy), R. Lombardi, and R. Claudi *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 455-458 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The dwarf nova SS Cygni was observed by IUE. The UV low resolution spectra show clear differences in the behavior of the accretion disk in quiescence and in outburst. A steady-state disk model can almost fit the continuum of the outburst spectra, while it fails the fit during quiescence phases. In quiescence, accretion disk behavior preserves memory of the preceding outburst. This memory is revealed from a different modulation of the continuum and of the total absolute fluxes of the emission lines versus the orbital period depending on the type of the preceding outburst. The He II 1640 A quiescent equivalent width behavior shows a large spread (0.93 to 23 A), which is consistent with models. ESA

N87-19254# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Astrofisica.
X-RAY, ULTRAVIOLET AND OPTICAL MONITORING OF THE X-RAY/BE TRANSIENT SYSTEM A 0535+26/HDE 245770 **c89**
F. Giovannelli, E. L. vanDessel (Belgian Royal Observatory, Brussels), M. Burger (Vrije Universiteit, Brussels, Belgium), C. deLoore, C. Bartolini (Bologna Univ., Italy), A. Guarnieri, A. Piccioni, I. N. Golynskaya (Academy of Sciences, USSR, Moscow), V. G. Kurt, T. A. Mizyakina et al *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV

Astronomy with IUE Sep. 1986 p 459-461 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The X-ray/Be transient system A 0535+26/HDE 245770 was monitored in X-ray, UV, and optical wavelengths to study the lighting of X-ray outbursts. The X-ray observations were carried out with ASTRON satellite on April 19, 1985 and March 17, 1986, dates of expected X-ray outbursts as predicted by the 111 day orbital periodicity. The measured fluxes are 6.5 mCrab and less than 5 mCrab in April 1985 and March 1986, respectively. The IUE observations were performed on January 29, and on March 13 and 15, 1986, predicted periods of quiescence and a bit earlier than an outburst, respectively. Optical spectroscopic observations were performed too. The absence of two X-ray expected outbursts implies either an inaccuracy of 111 day period or a temporary turning-off of the source. ESA

N87-19255# Armagh Observatory (Northern Ireland).
ULTRAVIOLET CONTINUUM VARIATIONS IN SCO X-1 c89
M. Ratcliffe, Allan J. Willis (University Coll., London, England), and A. M. T. Pollock (European Space Agency. European Space Operations Center, Darmstadt, West Germany) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 463-466 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The UV continuum variability of Sco X-1 was investigated using pairs of IUE SWP+LWR spectra secured sequentially at several epochs during 1978 to 1980, corrected for interstellar reddening with EB-V = 0.30 and the standard galactic law. Sco X-1 exhibits large variations in both the level and shape of its UV continuum, showing high and low intensity states, as at other wavelengths. In the range 1300 A to some longer wavelength lambda b its continuum is well matched by a thermal bremsstrahlung model, but beyond lambda b it follows a power law f nu varies as nu, closely matching the theoretical predictions by Felten and Rees (1972). Significant changes occur in lambda b with source brightness with important implications for emission models of Sco X-1. ESA

N87-19256*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. Dept. of Astrophysics.
IUE OBSERVATIONS OF THE DWARF NOVAE OY CAR IN SUPEROUTBURST c89
B. J. M. Hassall (Oxford Univ., England), T. Naylor, P. A. Charles, G. T. Bath, and G. Sonneborn *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 467-470 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

The May 1985 superoutburst of OY Car, an eclipsing member of the SU UMa subclass of dwarf novae, was observed extensively with IUE to obtain phase-resolved spectra throughout several orbital cycles, when the superhump was well developed and lay close in phase to the eclipse. The UV lines and continuum vary with orbital phase and show a strong UV eclipse coincident with the optical eclipse. This implies that the superhump source at eclipse is not a strong contributor in the ultraviolet. The UV emission line spectrum and lack of X-ray eclipse suggest the presence of an extended coronal region. The flux evolution observed is unusual in that gross changes occur during the decline from superoutburst. The later spectra actually appear hotter than spectra earlier in the decline, and suggest that, early on, the inner disk is obscured from view. ESA

N87-19257# University Coll., London (England). Dept. of Physics and Astronomy.
ULTRAVIOLET SPECTROSCOPY OF THE X-RAY BINARY HZ HER/HER X-1 c89
Stephen Boyle, Ian Howarth, Robert Wilson, and John Raymond *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 471-474 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

High and low resolution IUE spectra of HZ Her are examined to probe the primary site of line emission. The N V emission lines show a very small range of velocities; they must be formed in the X-ray heated hemisphere of the mass donor, within which lies the barycenter of the system. Line fluxes from low resolution spectrophotometry are compared with simple models to investigate the spatial distribution of the line forming regions. ESA

N87-19258*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ORBITAL VARIABILITY IN THE WIND OF THE MASSIVE X-RAY BINARY HD 153919/4U1700-37 c90
Ian D. Howarth (University Coll., London, England), Godelieve Hammerschlag-Hensberge (Amsterdam Univ., Netherlands), and Timothy Kallman *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 475-477 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03B

High resolution IUE spectra of HD 153919, the optical counterpart to 401700-37, were examined for evidence of the Hatchett-McCray effect. Although the resonance lines of C IV, N V, and Si IV are too heavily saturated to be very useful, the subordinate line of N IV at 1718 A clearly shows orbital variability in the correct sense to be explained as the removal of parent ions by the X-ray flux from the neutron star. ESA

N87-19259# Southampton Univ. (England). Dept. of Physics.
SHORT-PERIOD TEMPORAL STUDIES WITH IUE c89
Bernard J. Payne and Malcolm J. Coe *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 479-485 Sponsored by a UK Science and Engineering Research Council CASE Award (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE satellite was used to search for modulation in the ultraviolet flux from binary X-ray pulsars, over timescales comparable to the known pulse periods. This entailed developing a means of using the IUE for pulse phased spectroscopy with a resolution of 1/10th of the pulse period. The technique is described, and the results of observations of the pulsars Vela X-1, 4U1145-619 and A0535+26 are discussed. Results regarding residual sensitivity variations in the IUE SWP camera response perpendicular to dispersion are presented, together with an empirically-derived error-estimation curve for line-by-line spectra. ESA

N87-19260# Science Research Council, Chilton (England). Rutherford Appleton Lab.
TIDALLY INDUCED MASS LOSS IN IOTA ORIONIS c90
D. J. Stickland, C. Lloyd, C. D. Pike, A. J. Willis, and I. D. Howarth *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 487-490 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Mass loss in Iota Orionis, a massive O9 III + B1 III binary with a highly eccentric orbit was investigated. Coude spectra from RGO were used to update its ephemeris and establish a value for the apsidal motion. Combining the orbital elements, the astrophysical data (the primary is an O9 III standard star in the Orion Association), and photometry through a grazing eclipse the dimensions of the system were determined. This shows that at periastron, the centers of the stars are only separated by 1.5 times the sum of the radii, which suggests that strong tidal forces are generated and enhanced mass loss may be expected. Evidence of this was sought in high resolution IUE spectra taken through periastron passage: perturbations of the wind lines of C IV, N V and Si IV are seen. ESA

N87-19261# Chicago Univ., Ill. Dept. of Astronomy.
LIMITS ON THE LOCAL FLUFF FROM IUE Mg I DATA c90
P. C. Frisch, D. G. York, and J. R. Fowler *In* ESA Proceedings of

an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 491-492 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The known properties of the local interstellar medium (local fluff) are combined with IUE observations of the 2852 A line of Mg I 0.003/cc. If no other cloud is present, the geometry of the fluff in the direction of a background target star showing an equivalent width, W(mA), for the Mg I 2852 A line can be estimated from the relation W(2852 A)/L less than or = ne X 350, where L (pc) is the cloud extent and ne(percc) the electron density in the cloud. ESA

N87-19262*# Arizona Univ., Tucson. Lunar and Planetary Lab.
IUE/VOYAGER OBSERVATIONS OF LUMINOUS ACCRETION DISK SYSTEMS c89
T. E. Carone, R. S. Polidan, and R. A. Wade *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 493-496 (For primary document see N87-19150 11-88)
(Contract JPL-956729; Grant NAGw-587; Contract NAG5-441)
Avail: NTIS HC A99/MF E03 CSCL 03A

The importance of simultaneous IUE and Voyager observations of luminous accretion disk systems is shown. The composite spectra of SS Cyg, VW Hyi, CPD-48 1577, and V3895 Sgr show the changes which occur in the continuum flux distributions from 3200 A down to the Lyman limit. Results imply that current disk ingredients (i.e., blackbodies and Kurucz atmospheres) cannot explain the IUE/Voyager observations. ESA

N87-19263# Imperial Coll. of Science and Technology, London (England). Astrophysics Group.
MAGNITUDES OF SELECTED CENTRAL STARS OF PLANETARY NEBULAE c89
N. A. Walton, N. K. Reay, S. R. Pottasch (Groningen Rijksuniversiteit, Netherlands), and P. D. Atherton *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 497-501 Sponsored by UK Science and Engineering Research Council (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Narrow band continuum images of 21 planetary nebulae were obtained using a CCD camera at the prime focus of the Anglo-Australian Telescope. The nebulae were selected on the basis that their central stars were previously poorly detected or undetected. The images were used to determine visual magnitude for the nuclei of the planetary nebulae and calculate their corresponding Zanstra temperatures. The distribution of the planetary nebulae on the Log L-Log T plane is discussed in terms of theories of the evolution of the nuclei of planetary nebulae. A number of the central stars studied have high temperatures which can be explained with present theories if their masses are 1 solar mass. ESA

N87-19264# Science Research Council, Chilton (England). Rutherford Appleton Lab.
THE INTRINSIC COLOURS OF THE WOLF-RAYET STARS c89
G. Ford and D. J. Stickland *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 502-504 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Dearchived IUE data were used to deduce the reddening of all the Galactic Wolf-Rayet (WR) stars in the catalog of van der Hucht et al (1981) for which there existed narrow-band photometry and low-resolution spectra from both IUE spectrographs. The observed colors were thus transformed into intrinsic colors for comparison with previous estimates: the agreement is good, suggesting that, in general, the reddening of such stars is not peculiar. The dereddened energy distributions were approximated by Planck curves and UV color temperatures derived. These generally fall in the region of 50,000 to 100,000 K, supporting estimates of WR core temperatures. ESA

N87-19265# Science Research Council, Chilton (England). Rutherford Appleton Lab.
CV SERPENTIS: C III IN THE OPTICAL AND UV c89
D. J. Stickland, G. Ford, C. LLoyd, and A. J. Willis (University Coll., London, England) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 505-508 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The wind of the WC8 star in the binary CV Ser was modelled by a spherically symmetric series of shells through which the light of the 08-9 V star passes, along changing sight-lines, during the course of its 29 day period. Examination of the flux in the C III 1909A line on a series of IUE spectra taken at 0.1 phase intervals throughout the cycle, together with published optical photometry of the 1650A feature, which is dominated by C III multiplet 1, leads to an estimate of the excitation variation throughout the envelope. This could lead to a determination of the velocity law in the wind. ESA

N87-19266*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE INTERSTELLAR MEDIUM c90
J. Michael Shull *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 511-522 Prepared in cooperation with National Bureau of Standards, Boulder, Colo. (For primary document see N87-19150 11-88)
(Grants NAG5-193; NSG-7128)
Avail: NTIS HC A99/MF E03 CSCL 03B

Observations and models of interstellar matter in the Milky Way are reviewed. The general structure of the gas layer, high velocity gas, and heavy element depletion patterns are outlined. The IUE survey of Fe and Si abundances, and the correlation of Fe and Si depletions with infrared cirrus are described. Studies of neutral hydrogen may disagree with three-phase models of the interstellar medium, dominated by supernova remnants. The effects of shock waves on interstellar medium structure, the grain population, and refractory element abundances are considered. It appears that the frequency, distribution, energy, and dynamical effects of supernovae in the galaxy may be overestimated. ESA

N87-19267# European Southern Observatory, Garching (West Germany).
OBSERVATIONS OF ACTIVE GALACTIC NUCLEI WITH IUE AND COMPARISON WITH X-RAY DATA c89
M. H. Ulrich *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 523-532 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The properties of the ultraviolet continuum in active nuclei and its relation to the X-ray continuum are discussed. The IUE observations of BL Lac objects and Seyfert 1 galaxies are reviewed. The observational status of the study of the ultraviolet absorption lines is presented. ESA

N87-19268# University Coll., London (England).
THE ULTRAVIOLET ASTRONOMY MISSION - LYMAN c89
R. Wilson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 533-536 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The Lyman spaceborne astronomy mission to exploit the 900 to 1200 A region is introduced. The prime mission is the determination of the primordial deuterium abundance. This results in a requirement for a system of high sensitivity and spectral resolution. To complement this prime mission, it is proposed to include subsidiary spectrographs to cover higher UV (1200 to 2000 A) and lower EUV (100 to 350 A) wavelength ranges, but these will be accommodated within the overall constraints imposed by the prime mission. The nature of the 900 to 1200 A range is such that its exploitation will extend to most areas of astronomy, from

detailed observations or solar system objects, the interstellar medium, stars and galaxies to studies of cosmological significance. ESA

N87-19269# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE PROPOSED LYMAN FAR ULTRAVIOLET SPECTROSCOPIC EXPLORER c18
Jeffrey L. Linsky *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 537-549 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The scientific and technical proposals for the Lyman mission, a far ultraviolet astronomy satellite, are summarized. Lyman is designed to answer questions in astrophysics that require high resolution, high sensitivity spectroscopy in the 912 to 1200 A band and in the EUV, which cannot be answered by other means. The baseline concept consists of an 80 cm diameter glancing incidence telescope that feeds a Rowland circle spectrograph with deformed ellipsoidal gratings, and an EUV spectrograph. The design includes several slits with grazing flat mirrors on a slit wheel mechanism to direct the beam to different fixed gratings which could also permit low resolution and longer wavelength observations. The baseline is a low Earth orbit (500 to 600 km height circular) at 28 deg inclination, using the Explorer Bus, with the payload launched in the Shuttle (mounted sideways in the bay) and placed on the spacecraft in orbit. Observing efficiency is 35%. ESA

N87-19270# Bonn Univ. (West Germany). Sternwarte.
REFLECTION NEBULAE OBSERVED WITH THE IUE (REVIEW) c89
Klass S. deBoer *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 551-554 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE measurements of scattering of starlight by interstellar dust near Zeta Ori are reviewed. The wavelength dependence of the dust albedo and phase function are derived. A phase-function value between 0.1 and 0.8 is found, with a value near 0.6 at visual wavelengths. This means that all dust appears to be forward scattering. The albedo appears to be smaller towards shorter wavelengths than in the visual. ESA

N87-19271*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IUE STUDY OF THE VERY LOCAL INTERSTELLAR MEDIUM c89
R. C. Henry (Johns Hopkins Univ., Baltimore, Md.), J. Murthy, H. W. Moos, W. B. Landsman, J. L. Linsky (Joint Inst. for Lab. Astrophysics, Boulder, Colo.), A. Vidal-Madjar (Institut d'Astrophysique, Paris, France), and C. Gry (European Space Agency. ESA Tracking Station, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 555-558 Sponsored by NASA (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

The IUE and Copernicus results for the very local interstellar medium are compared. Despite its lower resolution, IUE produces results of comparable quality, giving important confirmation of Copernicus results on the density, temperature, turbulence, and deuterium-to-hydrogen ratio in the region within 10 pc of the Sun. The stars observed are in a very low-density quarter of the galaxy: multicomponent structure seen in other directions may not be present in the direction of most of the observed stars. The exceedingly low densities observed in certain directions encourages the idea that EUV studies of certain normal stars may be possible. ESA

N87-19272# Catania Univ. (Italy). Osservatori Astrofisica.
EXTINCTION AND DUST IN THE ORION REGION c90
A. Magazzu, G. A. Baratta, and G. Strazzulla *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 559-562 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Data from IUE were used to construct extinction curves for the stars exciting M43 and NGC 1973-1975-1977. The analysis of the curves, together with polarization measurements, indicate the lack of small dust grains and the presence of grains larger than usual in the surroundings of the stars. ESA

N87-19273# Queens Univ., Belfast (Northern Ireland). Dept. of Applied Mathematics and Theoretical Physics.
IUE AND OPTICAL STUDIES OF NEARBY INTERSTELLAR GAS c89
F. P. Keenan, B. Bates, and M. G. Catney *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 565-568 Sponsored by UK Science and Engineering Research Council (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Red-shifted high velocity interstellar gas components with velocities up to 100 km/sec were detected in the IUE spectra of stars in the Galactic direction e = 100 deg, b = 7 deg. These are compared with high resolution optical observations of the NaD interstellar lines, which allow the distribution of the gas to be mapped more extensively than in earlier surveys. Calculations of the temperature sensitive N(Mg I)/N(Na I) ratio are presented, and used with the UV results to partially derive physical conditions within several of the high velocity clouds. ESA

N87-19274# Institut d'Astrophysique, Paris (France).
THE CIRCUMSTELLAR GAS AROUND BETA PICTORIS c90
A. M. Lagrange, R. Ferlet, and A. Vidal-Madjar *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 569-571 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The red shifted components seen in IUE ultraviolet and visual lines of the gaseous component of the disk ground Beta Pictoris are discussed. They may be due to infalling of gas. Changes in time could be explained by strong inhomogeneities within 0.5 AU from the star. However, explanations based on stellar surface and near surface phenomena are feasible. ESA

N87-19275# Science Research Council, Chilton (England). Rutherford Appleton Lab.
THE INTERSTELLAR ABUNDANCE OF THE VOLATILE ELEMENTS SULPHUR AND ZINC IN HIGH DENSITY SIGHT-LINES c90
A. W. Harris and J. M. Mas Hesse (Universidad Complutense, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 573-576 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Depletion/density behavior of S and Zn was studied, using equivalent width data from Copernicus and IUE. The results provide evidence that the established dependence of depletion on mean hydrogen volume density extends to volatile elements. It appears that such elements may take part in the surface chemistry of grains and be important constituents of grain mantle material, although they probably do not contribute significantly to the bulk mass of grains. A comparison of Doppler widths derived for S II and P II in the same sight-lines suggests that the presently accepted oscillator strengths of the P II 1153 and 1302A lines may be inaccurate. ESA

N87-19276# Science Research Council, Chilton (England). Rutherford Appleton Lab.
THE CASE FOR DIFFUSE, COLLISIONALLY IONIZED INTERSTELLAR C IV AND SI IV BELOW Z = 1 kpc c90
Alan W. Harris and Gordon E. Bromage *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 577-580 (For

primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Highly ionized gas in the galactic disk and disc/halo interface region was studied using IUE observations of C IV and Si IV absorption in 19 codirectional sight-lines to early-type stars. Evidence for a generally distributed, collisionally ionized phase of this gas having a density in the plane of 3 times 10 to the minus 9th power/cc and a scale height in the range of 1 to 3 kpc is presented. It is shown that the use of a restricted range of sight-line directions in studies such as this may reduce confusion resulting from inhomogeneities in the distribution of the highly ionized medium. ESA

N87-19277*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ELEMENTAL ABUNDANCE DETERMINATION IN GASEOUS NEBULAE FROM IUE LINES c90
Robert H. Rubin and B. Zuckerman (California Univ., Los Angeles) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 581-583 (For primary document see N87-19150 11-88) (Grant NAG5-710)
Avail: NTIS HC A99/MF E03 CSCL 03B

A method for obtaining the C/O elemental abundance ratio for high excitation H II regions is discussed. This is applied to rederive C/O for the Orion Nebula from IUE observations using improved atomic data and extinction corrections. It is found that C/H is 20 to 40% lower than previously determined. When recombinations contribute importantly to (O II) 2470 and 7325 A emission, use of these lines for assessing the O(+) ionic abundance with the so-called empirical method is inadvisable. ESA

N87-19278# Florence Univ. (Italy). Dept. of Physics.
STATISTICAL ANALYSIS OF UV EXTINCTION CURVES TOWARDS OB ASSOCIATIONS c90
S. Aiello, B. Barsella (Pisa Univ., Italy), G. Chlewicki (Groningen Rijksuniversiteit, Netherlands), F. Ferrini (Pisa Univ., Italy), P. Patriarchi, and C. Sandi *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 585-588 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Multivariate statistical methods were applied to 115 UV extinction curves obtained from small dispersion, low resolution IUE spectra of early stars. Factor analysis shows that a three population dust model is most consistent with data. ESA

N87-19279# Consiglio Nazionale delle Ricerche, Florence (Italy). Dept. of Physics.
A STUDY OF UV EXTINCTION TOWARDS OB ASSOCIATIONS AND STAR-FORMING REGIONS BASED ON IUE DATA c90
S. Aiello, B. Barsella (Pisa Univ., Italy), G. Chlewicki (Groningen Rijksuniversiteit, Netherlands), J. M. Greenberg (Leiden Univ., Netherlands), P. Patriarchi (Florence Univ., Italy), and M. Perinotto *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 589-592 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Extinction curves for 115 stars were derived using the IUE data bank: 70% of them belong to OB associations. The sample provides good coverage of the galactic plane including objects located as far as 4 kpc from the Sun. The sample covers a variety of different areas including interesting objects such as the Carina Nebula and the Rho Ophiuchi Dark Cloud. While the older associations and field stars show extinction curves very close to the MIEC, younger objects show strong variations of the amount of the extinction in the far UV and, in some cases, also in the hump region. ESA

N87-19280# University Coll., London (England). Dept. of Physics and Astronomy.
INTERSTELLAR 2200 A, A NEW CHARGE TRANSFER SOLUTION? c90
David J. Carnochan *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 593-596 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

It is proposed that the interstellar 2200 A extinction feature is caused by charge transfer between H and Fe(+), Si(+), Mg(+). Apart from a much weaker feature near 1600A due to Al(+), Na(+), and Ca(+), no other detectable features are expected to occur. The charge transfer reaction must take place on the surface of grains. It is suggested that the broad diffuse features seen in the visible might be caused by charge transfer between simple molecules and common atoms. In particular 4430A may be caused by charge transfer between CH and Fe(+). ESA

N87-19281# Imperial Coll. of Science and Technology, London (England). Blackett Lab.
EVIDENCE FROM ULTRAVIOLET SPECTROSCOPY FOR STARBURSTS IN THE NUCLEI OF INTERACTING AND MERGING GALAXIES c90
R. D. Joseph, G. S. Wright, and A. H. Prestwich *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 597-600 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Short wavelength, low dispersion IUE spectra of an interacting galaxy, N2798, and a classic merging galaxy, N3256 were obtained. Both are unusually luminous infrared galaxies detected by IRAS. Absorption features due to Si IV and C IV are the most prominent features of these spectra. The UV observations are compared with IR observations of the galaxies. Results are interpreted in terms of the starbursts vs. monsters controversy for the underlying energy source powering luminous infrared galaxies. Results support the starbust theory. ESA

N87-19282# University Coll., London (England). Dept. of Physics and Astronomy.
THE ULTRAVIOLET CONTINUUM OF QUASARS c89
P. T. OBrien, P. M. Gondhalekar (Science Research Council, Chilton, England), and R. Wilson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 601-604 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE spectra of a large sample of quasars covering a wide redshift range were analyzed to determine the nature of the ultraviolet continuum and its relationship to other wavebands. At low redshifts the continuum shows definite curvature around Ly alpha steepening to give a continuum slope that when extrapolated to 2 kev lies just above the observed X-ray flux. There is evidence for evolution in the continuum in the sense that the slope of the continuum above Ly alpha is flatter at higher redshifts. The observed continuum shape at low redshifts is consistent with a thermal origin for the ultraviolet continuum. ESA

N87-19283# Bowling Green State Univ., Ohio. Dept. of Physics and Astronomy.
INSIGHTS TO THE NATURE OF THE BLR IN SEYFERT-1 GALAXIES c90
Ronald E. Stoner and Roger L. Ptak *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 605-609 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The IUE spectra of the nuclei of three bright Seyfert-1 galaxies (NGC4151, NGC5548 and Fairall9) were analyzed. They exhibit time variability in their broad emission-line profiles and in the underlying continuum. The detailed nature and the time scale of this variability are different from object to object, but there are unifying similarities. Both the continuum and the C IV 1550 A emission in the IUE spectra can be understood if the broad line region consists, at least in part, of an optically thick atmosphere

(or radial wind) expanding from a hot, spherical surface. In two of the objects, electron scattering in this expanding atmosphere has important effects on the C IV emission profile, and continuum, in qualitative agreement with the IUE observations. ESA

N87-19284# Space Telescope Science Inst., Baltimore, Md.
HIGH SIGNAL-TO-NOISE SPECTRA OF TWO INTERMEDIATE REDSHIFT QUASARS **c89**
A. L. Kinney, P. J. Huggins, A. E. Glassgold, and J. N. Bregman *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 610-612 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

High signal-to-noise short wavelength co-added IUE spectra for intermediate redshift quasars 1100 + 772, and 2201 + 315 are presented. The spectra were fit to a continuum plus UV emission lines. The fits give a good characterization of the continuum, the line ratios for the weak lines, the degree of symmetry of Ly alpha, and, for 1100 + 772, the separation of the narrow and broad line components of Ly alpha. The Ly alpha is highiy symmetrical in both objects, with very little NV. For 1100 + 772, the narrow component contributes significantly to the line profile; the N/B ratio is 0.22 + or - 0.06. When the narrow component is removed, the broad component is relatively flat topped. This is one of the few examples of a broad component with the narrow component removed, and it could have consequences for dynamical models. ESA

N87-19285# Milan Univ. (Italy). Dept. of Physics.
UV AND OPTICAL OBSERVATIONS OF 3C120 IN TWO DIFFERENT STATES **c89**
L. Maraschi, L. Chiappetti (Consiglio Nazionale delle Ricerche, Milan, Italy), J. Danziger (European Southern Observatory, Garching, West Germany), R. Falomo (Osservatorio Astronomico, Padova, Italy), E. G. Tanzi (Consiglio Nazionale delle Ricerche, Milan, Italy), and A. Treves *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 613-615 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The Seyfert galaxy 3C 120 was repeatedly observed during 1983 to 1986 in the optical, ultraviolet, and X-ray bands. The maximum amplitude variation, a factor 1.5 in the optical (5500 A) and 2 in the UV (1500 A), was observed between August and October-November 1983, not accompanied by a comparable variation at X-ray frequencies. The UV optical observations at these two epochs are discussed. ESA

N87-19286# Consiglio Nazionale delle Ricerche, Milan (Italy).
UV AND OPTICAL VARIABILITY OF THE LOW LUMINOSITY QUASAR PG 1351+64 **c89**
E. G. Tanzi, R. Falomo (Osservatorio Astronomico, Padova, Italy), M. A. Malkan (California Univ., Los Angeles), L. Maraschi (Milan Univ., Italy), E. Mediavilla, and A. Treves *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 617-619 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

A bright radio quiet quasar PG 1351+64 was observed by IUE. Observations obtained within a few months in 1982 to 1983 show variations in the 1200 to 2000A band up to a factor of 2. The source showed its brightest state, both in the optical and UV bands, in 1986 February. ESA

N87-19287*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
SEVEN YEARS OF IUE OBSERVATIONS OF THE BL LACERTAE OBJECT PKS 2155-304 **c89**
C. M. Urry *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 621-625 (For primary document see N87-19150 11-88)
(Grant NAG5-495)
Avail: NTIS HC A99/MF E03 CSCL 03A

Over 50 IUE spectra of the brightest known BL Lac object at ultraviolet wavelengths, PKS 2155-304, were reanalyzed using Gaussian extraction techniques that maximize the signal-to-noise. The ultraviolet continuum of PKS 2155-304 is well fitted by a power law model Fv varies as V sup-alpha, with an average spectral index for the combined SWP-LWR-P fits of less than alpha greater than 0.89 + or - 0.11 (standard deviation). While the ultraviolet intensity of PKS 2155-304 varies by a factor of 2, the spectral index changes very little and is uncorrelated with intensity. Timescales for ultraviolet variability are as short as 10 days. In one case, a well-matched pair of IUE images was obtained nearly simultaneously with a very soft X-ray measurement; the combined spectra clearly show a steepening between the ultraviolet and soft X-ray bands. The relevance of these findings to jet models and accretion models is discussed. ESA

N87-19288# Royal Greenwich Observatory, Herstmonceux (England).
THE SPECTRUM OF THE BROAD ABSORPTION LINE QSO PG 0946+310 FROM 550 TO 4250 A **c89**
Max Pettini and Alec Boksenberg *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 627-631 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The bright (B = 16.00) QSO PG 0946+301, the only known broad absorption line (BAL) QSO at intermediate redshift (Zem = 1.214) was studied using optical observations in the red, obtained with the 5 m Hale telescope at Palomar Observatory, and ultraviolet data acquired with IUE. The latter extend down to 550 A in the rest frame, unobscured by intervening absorption optically thick in the Lyman continuum, and thus give an unprecedented view of a number of spectral features (emission and absorption lines) until now not detected outside the solar system. Considered together, these optical and ultraviolet data provide fresh clues to the nature of the BAL phenomenon and the relationship between BAL and normal QSOs, they demonstrate the scientific potential of future far-ultraviolet missions. ESA

N87-19289*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE Mg II LINE PROFILE IN THE SEYFERT GALAXY NGC 4151: A NEW OUTFLOWING COMPONENT **c89**
Kieron J. Leech (Sussex Univ., Brighton, England), M. V. Penston (Royal Greenwich Observatory, Herstmonceux, England), M. A. J. Snijders, and T. Gull *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 633-640 Sponsored by NASA and NC Science and Engineering Research Council (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

The Mg II 2795, 2802A doublet in the Seyfert galaxy NGC 4151 was examined to search for velocity systems in absorption and emission. Evidence for a narrow, outflowing absorption system in Mg II having a velocity of +825 km/sec relative to the Sun, -165 km/sec relative to the systemic velocity of NGC 4151 is presented. This feature is not present in Ly alpha or C IV and possible explanations for this are considered. For the Mg II and C IV lines a model decomposition of the line profile is shown. ESA

N87-19290# California Univ., Los Angeles. Dept. of Astronomy.
NEW ACCRETION DISK MODELING OF ACTIVE GALACTIC NUCLEI AND QUASARS **c89**
Wei-Hsin Sun and Matthew A. Malkan *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 641-644 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Spectra of accretion disks hypothesized to produce the strong optical and ultraviolet flux in quasars and active galactic nuclei were calculated. The spectrum of radiation leaving the disk surface is described by non-LTE stellar atmospheres with high effective

temperatures (15,000 to 150,000 K) and low gravities rather than local blackbody approximations. The dominance of electron scattering opacity in the stellar atmospheres leads to spectra significantly harder than blackbodies of the same effective temperatures. The strong general relativistic effects of disk inclination on the spectrum seen by distant observers are included. Both of the effects lead to significantly lower estimates of accretion rates in quasars observed with IUE. ESA

N87-19291# European Space Agency. ESA Tracking Station, Madrid (Spain). IUE Observatory.
A DETAILED STUDY OF THE CIV1550 LINE PROFILE AND ADJACENT SPECTRAL FEATURES IN NGC4151 FROM 1978 UP TO 1983 c89
J. Clavel, A. Altamore (Osservatorio Astronomico, Rome, Italy), A. Boksenberg (Royal Greenwich Observatory, Hailsham, England), G. E. Bromage (Science Research Council, Chilton, England), A. Elvius (Stockholm Observatory, Sweden), D. Pelat (Observatoire de Paris-Meudon, France), M. V. Penston (Royal Greenwich Observatory, Hailsham, England), G. C. Perola (Osservatorio Astronomico, Rome, Italy), M. A. J. Snijders (Royal Greenwich Observatory, Hailsham, England), and M. H. Ulrich (European Southern Observatory, Garching, West Germany) *In its* Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 645-648 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The 1450 to 1720 A interval in the UV spectrum of the Seyfert 1 galaxy NGC 4151 was examined, using line profile fitting techniques to study temporal variations at 69 different epochs from 1978 to 1983. Over a distance range from 5 light-days up to 500 light-years from the nucleus, the velocity law is Keplerian. An intermediate region, whose density (10 million cc) velocity dispersion (1600 km/sec) and dimension (250 light-days) are intermediate between those of the broad and narrow line regions is identified. Evidence of gas expanding at 4000 km/sec at a few light-days from the nucleus is found. This outflow is presumably decelerated outward and partially obscured by an accretion disk seen almost edge-on. ESA

N87-19292# China Scientific and Technical Univ., Hofei. Center for Astrophysics.
AN ARCHIVAL STUDY OF IUE OBSERVATIONS OF LOW REDSHIFT QUASARS c89
F. H. Cheng, A. L. Kinney (Space Telescope Science Inst., Baltimore, Md.), and L. Z. Fang *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 649-652 Sponsored in part by NASA, IAU and Dr. Fuhua Huang (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03.

The emission line and continuum characteristics of a sample of 18 low redshift QSOs from the IUE Archives are presented. The spectral index is found to have a mean value of 1.22, which is considerably steeper than the index of the same spectral region for high redshift QSOs. The line ratios L alpha/H beta and C IV/L alpha for the sample, 9.4 + or - 1.9 and 0.61 + or - .06, respectively, are consistent with the values of the photoionization models. When the low redshift sample is extended with Seyfert galaxies, intermediate redshift QSOs and high redshift QSOs, the equivalent width of L alpha and CIV anticorrelates with the luminosity at 1450 A. The slope of the anticorrelation is seen to be steeper for the higher redshift samples than for the lower redshift samples. ESA

N87-19293*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE SPACE TELESCOPE IMAGING SPECTROGRAPH c89
Theodore R. Gull *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 653-659 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

Preliminary performance goals for the Space Telescope Imaging Spectrograph (STIS), selected by NASA for definition study as a second generation instrument on the Hubble Space Telescope (HST) are outlined. The STIS is a 2-dimensional spectrograph that will operate from 1050A-11000A at the limiting HST spatial resolution of 0.05 arcsec FWHM, with spectral resolutions of 100, 1200, 20,000, and 100,000 and a maximum field-of-view of 50X50 arcsec. Its basic operating modes include echelle mode (like IUE), long slit mode (for simultaneous spectra at 1000 positions on the target), slitless spectrograph mode, coronographic spectroscopy, photon time-tagging, and direct imaging. ESA

N87-19294# Observatoire de Strasbourg (France).
IUE LOW-DISPERSION SPECTRA REFERENCE ATLAS. VOLUME 2: PECULIAR STARS c89
A. Heck, D. Egret, B. J. M. Hassall (Oxford Univ., England), C. Jaschek, M. Jaschek, and A. Talavera (European Space Agency. ESA Tracking Station, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 661-664 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Difficulties in preparing the IUE low resolution spectra reference atlas (Volume 2) of stars with anomalous spectra are outlined. It is impossible to translate all peculiarity groups of the 3600 to 4800 A region into similarly structured peculiarity groups in the 1200 to 3200 A region. Thus one finds the same phenomenon as with normal stars: classifications based upon one spectral region have no strict equivalence in another spectral region. Examples of Hg-Mn versus Ga stars, Horizontal-Branch versus lambda Boo stars, hydrogen-deficient versus C II stars, and the case of subdwarfs are shown. ESA

N87-19295# Bonn Univ. (West Germany). Sternwarte.
LIGHT SCATTERING IN THE IUE TELESCOPE c89
Klass S. deBoer and Angelo Cassatella (European Space Agency. ESA Tracking Station, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 665-667 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The scattered light intensity measured in May 1986 in the IUE telescope near eta UMa over radial distances between 15' and 120' is presented. The scattering profile of the IUE follows a power law with exponent -2.1 for r greater than 40' and is steeper between 10' and 40'. The fraction of starlight scattered decreases smoothly by a factor 3 from 1300 to 2900A. About 10% of the targer light is scattered to outside the IUE large aperture and also 10% is scattered over the 40 pixels inside the large aperture. ESA

N87-19296*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CORRECTING OBSERVED STELLAR LYMAN ALPHA PROFILES FOR THE EFFECTS OF INTERSTELLAR ABSORPTION AND GEOCORONAL EMISSION c89
J. E. Neff (Joint Inst. for Lab. Astrophysics, Boulder, Colo.), J. L. Linsky, W. B. Landsman, and K. G. Carpenter *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 669-672 (For primary document see N87-19150 11-88)
(Contract NAS5-26409; Grant NAG5-82)
Avail: NTIS HC A99/MF E03 CSCL 03A

Techniques to compensate for interstellar absorption and geocoronal emission in IUE studies of late stars atmospheres were developed. Thus it is possible to determine the Lyman alpha flux from nearby cool stars using the low-resolution spectra in the IUE archives. The accuracy of such a procedure depends fundamentally upon the assumptions regarding the shape of the intrinsic profile and the density and velocity structure of the local interstellar medium, not upon measurement uncertainties of the low-resolution spectra. Geocoronal emission and saturated spectra are fatal only to a one-dimensional spectral analysis. When both

the spatial and the spectral dimensions are considered, the observed Lyman alpha flux can be recovered. ESA

N87-19297*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BIBLIOGRAPHICAL INDEX OF OBJECTS OBSERVED BY IUE 1978-85 **c89**
Jaylee M. Mead, Lee E. Brotzman, and Yoji Kondo *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 675-677 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

A literature search covering the years 1978 to 1985 identified 1134 papers describing studies using data obtained with the International Ultraviolet Explorer (IUE) satellite. The names of greater than 9400 astronomical objects discussed were recorded. The objects were compiled into a list, along with each reference, and sorted by object name or catalog number. Cross-identification tables for the multiple names are provided. The 64-page Table of References includes the titles of the articles. This index enables a user to tell immediately where to find published papers describing IUE observations of the objects of interest. ESA

N87-19298# Osservatorio Astronomico, Trieste (Italy).
INTERSTELLAR C IV AND Si IV IN THE LOCAL INSTELLAR MEDIUM(?) **c90**
P. Molaro, G. Vladilo, and J. E. Beckman *In* European Space Agency, Paris, France. Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 678-682 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Study of a sample of late-B fast rotators revealed narrow absorptions of C IV and Si IV in the direction of 6 stars within 200 pc of the Sun. The features are faint and narrow and in a few cases superimposed on broader and more complex profiles. It is not clear if they originate in the surroundings of the star or in the diffuse interstellar medium. The FWHMs of the absorptions, in some cases at the IUE limit, point to an interstellar origin, but nearly all the stars in which C IV and Si IV are detected are Be and the absorptions could in fact be associated with the extended envelope around the stars. ESA

N87-19299# Space Telescope Science Inst., Baltimore, Md.
ULTRAVIOLET STANDARD STARS FOR CALIBRATION OF THE HUBBLE SPACE TELESCOPE Progress Report **c89**
J. C. Blades, A. Nota, R. C. Bohlin, A. V. Holm, A. W. Harris (European Space Agency. ESA Tracking Station, Madrid, Spain), and C. Gry *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 683-685 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Progress in establishing a set of standard stars with IUE for calibrating the scientific instruments on-board Space Telescope is summarized. ESA

N87-19300# Observatoire de Paris-Meudon (France).
THE ULTRAVIOLET TO INFRARED CONTINUUM OF NARROW EMISSION LINE ACTIVE GALAXIES **c89**
C. Boisson and F. Durret (Institut d'Astrophysique, Paris, France) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 687-689 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The overall continua of nine narrow line active galaxies are presented from the UV to the far IR. The nonstellar IR distribution is clearly not an extrapolation of the UV and optical spectra. The nonstellar components include a nonthermal power law continuum in the optical (steeper than typical values for Seyfert 1 objects), a thermal UV component, and 3 main dust components in the IR with typical temperatures of 40, 150, and 1000 K and dust masses of the 2 first components in the ranges 1.2 million to 14 million and 800 to 420 solar masses respectively. The existence of true narrow line objects differing from obscured broad line galaxies by the intrinsic faintness and steepness of their nonstellar continuum, as well as by the absence of a broad line region, is derived. ESA

N87-19301# Leicester Univ. (England). Dept. of Astronomy.
CONSTRAINTS ON VISCOSITY IN ACCRETION DISKS FROM UV VARIABILITY IN AGNS **c90**
Bozena Czerny and Michal Czerny *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 691-692 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The influence of accretion disk instabilities on the UV fluxes of Seyfert 1 galaxies was studied. The observed characteristic timescales of variability are consistent with the interpretation that most of the UV radiation originates in an accretion disk, and that thermal instabilities in the disk are responsible for the luminosity changes. However, another possible explanation is changes in absorption due to intervening clouds from the broad line region (BLR). In order to distinguish between these two hypotheses, more detailed predictions of the time dependence of the continuum in different wavelength regions as well as of the reaction of the BLR, are necessary. ESA

N87-19302# Leicester Univ. (England). Dept. of Astronomy.
UV EMISSION LINES IN GALACTIC NUCLEI: PREDICTIONS FROM THE DUELLING WIND MODEL **c90**
M. D. Smith and D. J. Raine *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 693-695 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The Duelling Wind Model is used to interpret broad line regions (BLR) in IUE data of source NGC 4151. Line intensities, widths, and response times are all consistent with a 2 million solar mass central engine, an active phase luminosity close to the Eddington limit and a broad line density maximum of 10 to the 12th power cc at a radius of 2 times 10 to the 16th power cm. It is shown how the delayed response of the line emission to the continuum can be used to test the model. Besides a 5 day speed-of-light time lag, the emission line strength responds to the previous 100 to 200 days of nuclear activity (due to the density of the disk wind). This appears in the cross-correlated data of Gaskell and Sparke (1986) and can be distinguished from an alternative explanation, an extended BLR, through the associated response of the line shape and width. ESA

N87-19303# European Space Agency. ESA Tracking Station, Madrid (Spain).
AN ULTRAVIOLET ANALYSIS OF THE PECULIAR GALAXY NGC 5253 **c89**
R. Gonzalez-Riestra, M. Rego (Universidad Complutense, Madrid, Spain), and J. Zamorano *In its* Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 697-699 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The UV spectrum of galaxy NGC 5253 was analyzed using IUE images. The spectrum of the nucleus shows a very blue continuum with several absorption lines typical of early-type stars. The presence of the C III 1910 A and C II 2326 A nebular emission lines indicates that the effective temperature of the ionizing stars cluster must be greater than 35,000 K. The spatial analysis of the images reveals the presence of several knots in agreement with optical observations. The comparison of the UV spectra with theoretical models of evolution of a cluster of young stars shows that either the UV extinction law is intermediate between the galactic and the Large Megellanic Cloud one, as expected in a metal-poor system, or that the UV extinction is lower than the value derived from the Balmer decrement. ESA

N87-19304# European Space Agency. ESA Tracking Station, Madrid (Spain).
OPTICAL AND UV SPECTROPHOTOMETRY OF A NORMAL SEYFERT 1: NGC5548 **c89**
W. Wamsteker, P. M. Rodriguez, J. Clavel, A. Cassatella, A. Talavera, C. Gry, R. Gilmozzi, C. Lloyd, H. Netzer (Wise Observatory, Tel Aviv, Israel), B. Wills (Texas Univ., Austin) et al *In its* Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 701-703 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

Variations of the UV continuum and the strongest emission lines for NGC5548 are presented. The relations between the lines and continuum show large variations in the Ba decrement, closer to recombination when brighter. ESA

N87-19305# Liege Univ. (Belgium). Inst. d'Astrophysique.
MULTIFREQUENCY OBSERVATIONS FOR THE SEYFERT 2: NGC3393 **c89**
A. Diaz, W. Wamsteker (European Space Agency. ESA Tracking Station, Madrid, Spain), and A. Prieto (Universidad Complutense, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 705-708 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The UV and optical spectra of NGC3393, a Seyfert 2 galaxy, are presented. This galaxy presents the opportunity to measure the reddening in several differents ways using typical emission lines such as L-alpha He II, and the Balmer lines with a good signal-noise ratio. Models to reproduce the fluxes observed, supposing a two component model with an overabundance of nitrogen are discussed. The overall continuum distribution from the far infrared to the UV is shown. ESA

N87-19306# Science Research Council, Chilton (England). Rutherford Appleton Lab.
VARIABILITY OF EMISSION LINES IN QUASAR SPECTRA: Q0405-123 AND Q1202+281 **c89**
P. M. Gondhalekar, P. T. OBrien (University Coll., London, England), and R. Wilson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 711-714 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The ultraviolet light curves of two quasars, Q0405-123 and Q1202+281 are described. In these spectra, and particularly in the spectrum of Q1202+281, both the continuum and emission lines are variable over a short time scale. These data in conjunction with data on other active galactic nuclei (AGNs) demonstrate that variability of permitted emission lines is common to AGNs over a large luminosity range. The time-lag between a change in the continuum and the corresponding change in the permitted emission lines is short (less than 41 days) in these two quasars, which means that the broad line region (BLR) is considerably smaller than has been assumed in the past. The implications of these observations for the accepted models of BLR are discussed. ESA

N87-19307# Science Research Council, Chilton (England). Rutherford Appleton Lab.
ULTRAVIOLET LIGHT CURVE OF THE DOUBLE QUASAR QO957+561, A,B AND DETERMINATION OF THE HUBBLE CONSTANT **c89**
P. M. Gondhalekar, R. Wilson (University Coll., London, England), A. K. Dupree (Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.), and B. F. Burke (Massachusetts Inst. of Tech., Cambridge) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 715-717 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

The change, between 1979 and 1983, in the ultraviolet continuum of the double quasar Q0957+561 A,B is described. A possible time delay between the light variation in the two images is 1.8 + or - 0.2 yr. This time delay suggests that the most probable value of the Hubble constant is 67 + or - km/sec/Mpc up to a redshift of 1.41. ESA

N87-19308*# Hughes Aircraft Co., El Segundo, Calif. Space and Communications Group.
STUDY OF NEW SYSTEMS CONCEPTS FOR A TITAN ATMOSPHERIC PROBE Final Technical Report
Doug Bernard, Todd Citron, Robert Drean, Scott Lewis, Martin Lo, John McCarthy, Robert Soderblom, Dave Steffy, Tina Vargas, and Marty Wolff Apr. 1986 198 p
(Contract NAS2-12049)
(NASA-CR-177394; NAS 1.26:177394) Avail: NTIS HC A09/MF A01 CSCL 22A

Results of a systems concepts study for a Titan Probe were examined. The key tradeoffs performed are described in detail. Mass breakdown of each Probe subsystem or major element were given. The mission analysis performed to determine compliance with the high altitude sampling and descent time requirements are described. The baseline Descent Module design was derived. The element of the Probe System left on the Carrier after separation were described. B.G.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N87-19309 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
MULTIWAVELENGTH MONITORING OF THE DWARF NOVA VW HYI. 1: OVERVIEW
J. E. Pringle (Oxford Univ., England), F. M. Bateson, B. J. M. Hassall (European Space Agency. ESA Tracking Station, Madrid, Spain), J. Heise (Laboratorium voor Ruimteonderzoek, Utrecht, Netherlands), J. B. Holberg (Arizona Univ., Tucson), R. S. Polidan, S. vanAmerongen (Amsterdam Univ., Netherlands), H. vanderWoerd (Laboratorium voor Ruimteonderzoek, Utrecht, Netherlands), J. vanParadijs (Amsterdam Univ., Netherlands), and F. Verbunt Sep. 1986 49 p Submitted for publication
(MPE-Preprint-70-Pt-1; ETN-87-99327) Copyright. Avail: Issuing Activity

The outburst mechanism of dwarf nova VW Hydri is discussed. Two explanations of ordinary outbursts are proposed. All or most of the matter transferred in quiescence is accreted by the white dwarf, so that the outbursts are due to bursts of mass transfer. Alternatively, all or most of the matter transferred in quiescence is accumulated in the accretion disk, and deposited on the white dwarf by a disk instability during outburst. Superoutburst observations strengthen the suggestions of Bateson (1977) and Marino and Walker (1979) that all superoutbursts are triggered by an ordinary outburst. ESA

N87-19310*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE LARGE DEPLOYABLE REFLECTOR (LDR) REPORT OF THE SCIENCE COORDINATION GROUP
1 Oct. 1986 109 p
(Contract NAS7-918)
(NASA-CR-180235; JPL-PUB-86-46; NAS 1.26:180235) Avail: NTIS HC A06/MF A01 CSCL 03A

The Large Deployable Reflector (LDR) is a telescope designed to carry out high-angular resolution, high-sensitivity observations at far-infrared and submillimeter wavelengths. The scientific rationale for the LDR is discussed in light of the recent Infrared Astronomical Satellite (IRAS) and Kuiper Airborne Observatory (KAO) results and the several new ground-based observatories planned for the late 1980s. The importance of high sensitivity and high angular resolution observations from space in the submillimeter

region is stressed. The scientific and technical problems of using the LDR in a light bucket mode at approx. less than 5 microns and in designing the LDR as an unfilled aperture with subarcsecond resolution are also discussed. The need for an aperture as large as 20 m is established, along with the requirements of beam-shape stability, spatial chopping, thermal control, and surface figure stability. The instrument complement required to cover the wavelength-spectral resolution region of interest to the LDR is defined. Author

N87-19311*# California Univ., Berkeley. Space Sciences Lab.
RESEARCH IN EXTREME ULTRAVIOLET AND FAR ULTRAVIOLET ASTRONOMY Semiannual Status Report, 1 Jun. - 31 Dec. 1986
C. S. Bowyer 3 Feb. 1987 3 p
(Grant NGR-05-003-450)
(NASA-CR-180186; NAS 1.26:180186) Avail: NTIS HC A02/MF A01 CSCL 03A

Analysis and interpretation continued on data generated by the flight of 27.086 in April of 1986 and by the successful UVX mission. Optical and mechanical design of the 1 meter EUV telescope, planned for launch with the large SPARTAN type carrier, ASTRO-SPAS, was also continued. The major effort centered on the preparation of flight 27.106, scheduled to launch in September, 1986. Work which was performed included: design of the skins and bulkheads; completion of the optical, mechanical, and electrical design; purchase of the major components of the instruments; assemblage of the electrical components; and performance of theoretical work, to support the data interpretation. B.G.

N87-19312# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVOLUTION OF 3C 273 AT 10.7 GHz
M. H. Cohen (California Inst. of Tech., Pasadena), J. A. Zensus, J. A. Biretta (Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.), G. Comoretto (Consiglio Nazionale delle Ricerche, Rome, Italy), P. Kaufmann, and Z. Abraham Dec. 1986 13 p Submitted for publication
(INPE-4087-PRE/1032) Avail: NTIS HC A02/MF A01

The quasar 3C 273 has been observed at 10.7 GHz at three epochs spanning 1984.1 to 1985.6. Two new superluminal components, C5 and C7a, are separating from the core with apparent transverse velocity V/c = (8.0 + or - 0.2)/h. The old components C3 and C4 may still be recognizable, with C4 having moved from 2.5 to perhaps 10 mas from the core in seven years. Non-monotonic curvature near the core is confirmed. Author

N87-19313*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE IONIZATION STRUCTURE OF THE ORION NEBULA: INFRARED LINE OBSERVATIONS AND MODELS
J. P. Simpson (Lick Observatory, Santa Cruz, Calif.), R. H. Rubin (California Univ., Los Angeles), E. F. Erickson, and M. R. Haas (Mycol, Inc., Sunnyvale, Calif.) Oct. 1986 46 p *In its* Preprint Series No. 63
(NASA-TM-88368; A-86421; NAS 1.15:88368) Avail: NTIS HC A03/MF A01 CSCL 03A

Observations of the (O III) 52 and 88 micron lines and the (N III) 57 micron line have been made at 6 positions and the (Ne III) 36 micron line at 4 positions in the Orion Nebula to probe its ionization structure. The measurements, made with a -40' diameter beam, were spaced every 45' in a line south from and including the Trapezium. The wavelength of the (Ne III) line was measured to be 36.013 + or - 0.004 micron. Electron densities and abundance ratios of N(++)/O(++) have been calculated and compared to other radio and optical observations. Detailed one component and two component (bar plus halo) spherical models were calculated for exciting stars with effective temperatures of 37 to 40,000K and log g = 4.0 and 4.5. Both the new infrared observations and the visible line measurements of oxygen and nitrogen require T sub eff approx less than 37,000K. However, the double ionized neon requires a model with T sub eff more than or equal to 39,000K, which is more consistent with that inferred from the radio flux or spectral type. These differences in T sub eff are not due to effects of dust on the stellar radiation field, but are probably due to inaccuracies in the assumed stellar spectrum. The observed N(++)/O(++) ratio is almost twice the N(+)/O(+) ratio. The best fit models give N/H = 8.4 x 10 to the -5 power, O/H = 4.0 x 10 to the -4 power, and Ne/H = 1.3 x 10 to the -4 power. Thus neon and nitrogen are approximately solar, but oxygen is half solar in abundance. From the infrared O(++) lines it is concluded that the ionization bar results from an increase in column depth rather than from a local density enhancement. Author

N87-19314*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FAR INFRARED SPECTROSCOPY OF STAR FORMATION REGIONS IN M82
P. B. Duffy (Stanford Univ., Calif.), E. F. Erickson, M. R. Haas (Mycol, Inc., Sunnyvale, Calif.), and J. R. Houck (Cornell Univ., Ithaca, N.Y.) Oct. 1986 27 p *In its* Preprint Series No. 62
(NASA-TM-88369; A-86422; NAS 1.15:88369) Avail: NTIS HC A03/MF A01 CSCL 03A

Emission lines of (O III) at 52 microns and 88 microns and of (N III) at 57 microns in the nucleus of the galaxy M82 have been observed from the Kuiper Airborne Observatory with the facility's cooled grating spectrometer. The (N III) line has not been previously detected in any extragalactic source. The fluxes in the lines indicate approx 4 x 10 to the 7th power M of ionized gas and a large population of massive stars (equivalent to 5 x 10 to the 5th power 08.5 stars), sufficient to power the infrared luminosity of the nucleus. We use the 52 to 88 micron line intensity ratio to find an average electron density of 210 + or 75 in the nucleus; this is 10 to 100 times lower than values typically observed in individual compact HII regions in our Galaxy. The relative line strengths of the (O III) and (N III) lines imply an N(++)/O(++) ratio of 0.45 + or - 0.1, significantly lower than is measured by the same method in individual HII regions at similar galactocentric distances (equal to or less than 400 pc) in our Galaxy. This lower N(++)/O(++) ratio may be due to a lower N/O ratio, higher stellar temperatures, or both, in M82. At spectral resolutions of approx. 90 km/s, all three line profiles are similarly asymmetric. They can be well fitted by two Gaussian distributions with widths of approx. 150 km/s and central velocities of approx. 110 and approx. 295 km/s, bracketing the systemic velocity of the nucleus of approx. 210 km/s. Within uncertainties, both the N(++)/O(++) ratio and the electron density are the same for both Gaussian components; this indicates no major large-scale gradient in either quantity within the nucleus. Author

N87-19315*# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
BOUNDARY CONDITIONS FOR THE PALEOENVIRONMENT: CHEMICAL AND PHYSICAL PROCESSES IN THE PRE-SOLAR NEBULA Semiannual Status Report, 16 Aug. 1986 - 15 Feb. 1987
William M. Irvine and F. Peter Schloerb Feb. 1987 8 p
(Contract NASw-436)
(NASA-CR-180253; NAS 1.26:180253; SASR-8) Avail: NTIS HC A02/MF A01 CSCL 03A

Detailed study of the first interstellar hydrocarbon ring, cyclopropenylidene (C3H2), is continuing. The singly deuterated isotope of this molecule, C3HD, was observed in several cold interstellar clouds. The results of a large survey for C3H2 in galactic sources of various types will soon be completed. It appears that cyclopropenylidene is present in virtually all interstellar clouds of at least moderate density. In order to make the first determinations of the CO2/CO abundance ratio in interstellar sources, observations of protonated CO2 were pursued. The spectrum from 18.5 to 22 GHz for several interstellar clouds is being systematically measured. Particular attention is being given to the cold, dark clouds TMC-1 and L124N, which may be formation sites for solar mass stars. The phenomena of maser emission from molecules of methanol is being studied in certain interstellar clouds. A comparison of 1 millimeter continuum emission from dust with the column density of carbon monoxide as determined from the rare

C(18)O isotope for 4 molecular clouds in the Galaxy is nearing completion. Papers published during the period of this report are listed. B.G.

N87-19151# Observatoire de Besancon (France).
COMETS
M. C. Festou *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 3-9 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19158# Osservatorio Astrofisico di Arcetri, Florence (Italy).
IUE AND SKYLAB SPECTRA OF SOLAR-TYPE STARS AND OF SPATIALLY-RESOLVED SOLAR REGIONS
R. Pallavicini, M. Cerruti-Sola, and C. C. Cheng (Naval Research Lab., Washington, D. C.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 45-47 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19159# Institut d'Astrophysique, Paris (France).
SEARCH FOR Be IN FOUR COOL CP STARS
M. Gerbaldi, R. Faraggiana (Trieste Univ., Italy), and P. Molaro *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 49-52 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19161*# Tufts Univ., Medford, Mass. Dept. of Physics and Astronomy.
SIMULTANEOUS IUE AND VLA OBSERVATIONS OF YZ CANIS MINORIS, AD LEONIS AND LAMBDA ANDROMEDAE
Robert F. Willson and Kenneth R. Lang *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 57-60 (For primary document see N87-19150 11-88)
(Grant NAG5-477; Contract N000-14-86-K-0068; Grant AF-AFOSR-83-0019)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19163*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ULTRAVIOLET LINES OF CARBON, NITROGEN, AND OXYGEN IN THE IUE SPECTRUM OF THE FIELD HORIZONTAL-BRANCH A STAR HD 109995
David S. Leckrone and Saul J. Adelman *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 65-69 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19164# Observatorium Hoher List, Bonn (West Germany).
SEARCH FOR CHROMOSPHERIC Mg II EMISSION IN Ap-TYPE STARS
W. Seggewiss *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 71-74 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19169# Colorado Univ., Boulder. Center for Astronomy and Space Astronomy.
UV AND OPTICAL OBSERVATIONS OF AT MICROSCOP 2
T. R. Ayres, O. Elgaroey (Oslo Univ., Norway), and P. Joraas *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 91-94 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19170# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Astrofisica Spaziale.
X-RAY, ULTRAVIOLET, OPTICAL, INFRARED AND RADIO SIMULTANEOUS OBSERVATIONS OF RU LUPI
F. Giovannelli, A. A. Vittone, C. Rossi (Rome Univ., Italy), I. Nastari, G. S. Bisnovatyi-Kogan (Academy of Sciences, USSR, Moscow), I. M. Golynskaya, V. G. Kurt, T. A. Mizyakina, E. Yu. Shafer, V. M. Shamolin et al *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 95-98 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19171*# Colorado Univ., Boulder. Center for Astrophysics and Space Astronomy.
Fe II EMISSION LINE PROFILES IN SPECTRA OF HIGH LUMINOSITY NON-CORONAL STARS
Kenneth G. Carpenter *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 99-102 (For primary document see N87-19150 11-88)
(Grant NAG5-797)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19173# Conselho Nacional de Pesquisas, Rio de Janeiro (Brazil).
SIMULTANEOUS UV-OPTICAL OBSERVATIONS OF ISOLATED T-TAURI STARS: THE V4046 SGR CASE
R. delaReza, G. Quast, C. A. Torres, M. Mayor (Geneva Observatory, Switzerland), G. Meylan, and F. LlorentedeAndres (Instituto Nacional de Tecnica Aeroespacial, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 107-111 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19175*# Howard Univ., Washington, D. C. Dept. of Physics and Astronomy.
STARS OF TYPE MS WITH EVIDENCE OF WHITE DWARF COMPANIONS
Benjamin F. Peery, Jr. *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 117-120 (For primary document see N87-19150 11-88)
(Grants NAGw-545; NAG5-772)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19178# Oslo Univ. (Norway). Inst. of Theoretical Astrophysics.
EUV LINE EMISSION AS A DIAGNOSTIC OF COOL GIANT STARS
P. Joraas *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 129-132 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19181*# Indiana Univ., Bloomington.
SYNTHETIC SPECTRA OF COOL STARS FOR THE WAVELENGTH RANGE 2550-3200 A
Joel A. Eaton *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 141-144 (For primary document see N87-19150 11-88)
(Grant NAG5-182)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19183*# Indiana Univ., Bloomington.
ULTRAVIOLET SPECTRA OF THE N-TYPE CARBON STAR TX PISCIUM
Hollis R. Johnson, Donald Luttermoser, John H. Baumert (Computer Sciences Corp., Baltimore, Md.), Francois Querci (Observatoire de Toulouse, France), and Monique Querci *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 149-152 (For primary document see N87-19150 11-88)

(Grant NAG5-182)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19184*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
DOPPLER IMAGING OF ACTIVE REGIONS ON AR LACERTAE
J. E. Neff, F. M. Walter (Colorado Univ., Boulder), and M. Rodono (Catania Astrophysical Observatory, Italy) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 153-154 Sponsored by CNR, Max-Planck Inst. and NATO (For primary document see N87-19150 11-88)
(Contract NAS5-26409; Grant NAG5-82)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19185# Oslo Univ. (Norway). Inst. of Theoretical Astrophysics.
OPTICAL AND ULTRAVIOLET OBSERVATIONS OF A GIANT STELLAR FLARE ON AD LEO
B. R. Pettersen, S. L. Hawley (Texas Univ., Austin), and B. N. Andersen (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 157-159 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19188*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
HIGH DISPERSION IUE OBSERVATIONS OF HYBRID-CHROMOSPHERE STARS
A. Brown, D. Reimers (Hamburger Sternwarte, West Germany), and J. L. Linsky *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 169-172 (For primary document see N87-19150 11-88)
(Contract NAS5-26409; Grants NAG5-82; DFG-RE-353/6-4)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19190*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
ULTRAVIOLET AND OPTICAL VARIABILITY OF RY TAURI
A. Brown, J. L. Linsky, S. A. Drake (Systems and Applied Sciences Corp., Lanham, Md.), and W. Herbst (Van Vleck Observatory, Middletown, Conn.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 177-179 (For primary document see N87-19150 11-88)
(Contract NAS5-26409; Grant NAG5-82)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19197# Computer Sciences Corp., Greenbelt, Md. Astronomy Program.
IUE OBSERVATIONS OF THE ERUPTIVE PRE-MAIN SEQUENCE OBJECT FU ORIONIS
Rosalie Ewald, Catherine L. Imhoff, and Mark S. Giampapa *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 205-207 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19200# Boston Univ., Mass.
CHROMOSPHERIC EMISSION IN OPEN CLUSTER RED GIANTS
Kenneth A. Janes and Graeme H. Smith (Dominion Astrophysical Observatory, Victoria, British Columbia) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 217-219 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19201*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LONG-TERM SPECTROSCOPIC MONITORING OF ALPHA ORIONIS
G. Sonneborn, S. L. Baliunas (Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.), A. K. Dupree, E. F. Guinan, and L. Hartmann *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 221-223 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19202# Uppsala Ionospheric Observatory (Sweden).
TZ FORNACIS: AN ECLIPSING CAPPELLA-LIKE SYSTEM OBSERVED WITH THE IUE
K. Eriksson, M. Saxner, B. Gustafsson (Stockholm Observatory, Sweden), T. R. Ayres (Colorado Univ., Boulder), J. L. Linsky (Joint Inst. for Lab. Astrophysics, Boulder, Colo.), and J. Andersen (Copenhagen Univ., Denmark) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight years of UV Astronomy with IUE Sep. 1986 p 225-227 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19204# Osservatorio Astronomico, Trieste (Italy).
EFFECTS OF INTERSTELLAR ABSORPTIONS ON Mg II CHROMOSPHERIC EMISSIONS
G. Vladilo, L. Crivellari, P. Molaro, J. E. Beckman (Consejo Superior Investigaciones Cientificas, Tenerife, Spain), and R. Genova *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 233-236 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19205*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
A REVIEW OF THE ULTRAVIOLET STUDIES OF GALACTIC NOVAE
Sumner Starrfield (Arizona State Univ., Tempe) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 239-245 Sponsored in part by DOE (For primary document see N87-19150 11-88)
(Grants NAG5-481; NSF AST-83-14788; NSF AST-85-16173)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19209# European Space Agency. ESA Tracking Station, Madrid (Spain). IUE Observatory.
EIGHT YEARS OF UV OBSERVATIONS OF THE RECURRENT NOVA T CORONAE BOREALIS
A. Cassatella, R. Gilmozzi, and P. L. Selvelli (Osservatorio Astronomico, Trieste, Italy) *In its* Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 277-278 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19210# Kiel Univ. (West Germany). Inst. fuer Theoretische Physik und Sternwarte.
ANALYSIS OF FAINT BLUE STARS AT HIGH GALACTIC LATITUDES
U. Heber and G. Langhans *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 279-282 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19214*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IUE SURVEY OF PLANETARY NEBULAE IN THE LARGE AND SMALL MAGELLANIC CLOUDS
T. R. Gull, A. G. Michalitsianos, S. P. Maran, T. P. Stecher, L. H. Aller (California Univ., Los Angeles), and C. D. Keyes *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 295-298 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19215*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STATUS REPORT ON IUE ATLAS OF PLANETARY NEBULAE

AND RELATED OBJECTS
Walter A. Feibelman, Nancy A. Oliversen (Computer Sciences Corp., Baltimore, Md.), and Joy Nichols-Bohlin *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 299-301 (For primary document see N87-19150 11-88)
(Contract NAS5-28749)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19216# Rome Univ. (Italy). Ist. Astronomico.
STUDY OF THE ULTRAVIOLET SPECTRUM OF ETA CARINAE
A. Altamore, G. B. Baratta (Osservatorio Astronomico, Rome, Italy), A. Cassatella (European Space Agency. ESA Tracking Station, Madrid, Spain), L. Rossi (Consiglio Nazionale delle Ricerche, Frascati, Italy), and R. Viotti *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 303-306 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19217# Osservatorio Astronomico, Turin (Italy).
IUE OBSERVATIONS OF MASSIVE STARS IN NEARBY GALAXIES
Luciana Bianchi, Phil Massey (Kitt Peak National Observatory, Tucson, Ariz.), and John Hutchings (Dominion Astrophysical Observatory, Victoria, British Columbia) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 307-309 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19219# Observatoire de Strasbourg (France).
SPECTRUM SYNTHESIS OF UV Ga II AND Ga III LINES COMPARED TO IUE OBSERVATIONS OF HD 25823 AND HD 17081
R. Freire-Ferrero and M. C. Artu (Observatoire de Paris-Meudon, France) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 315-318 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19224# University Coll., London (England). Dept. of Physics and Astronomy.
GROSS ULTRAVIOLET SPECTRAL VARIABILITY IN HD 45166 (qWR + B8V)
Allan J. Willis and David J. Stickland (Science Research Council, Chilton, England) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 335-338 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19225# University Coll., London (England). Dept. of Physics and Astronomy.
HIGH RESOLUTION IUE OBSERVATIONS OF HD 62910 WN6-C4
Allan J. Willis and David J. Stickland (Science Research Council, Chilton, England) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 339-342 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19228*# Washington Univ., Seattle. Dept. of Astronomy.
DOPPLER TOMOGRAPHY OF THE STELLAR WIND OF THE WOLF-RAYET BINARY STAR V444 CYGNI
Douglas N. Brown and Steven N. Shore (New Mexico Inst. of Mining and Technology, Socorro) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 353-356 (For primary document see N87-19150 11-88)
(Grant NAG5-357)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19229# New Mexico Inst. of Mining and Technology, Socorro. Astrophysics Research Center.
IUE OBSERVATIONS OF THE HENIZE-CARLSON SAMPLE OF PECULIAR EMISSION LINE SUPERGIANTS: THE GALACTIC ANALOGS OF THE MAGELLANIC ZOO
Steven N. Shore, Douglas N. Brown (Washington Univ., Seattle), and N. Sanduleak (Case Western Reserve Univ., Cleveland, Ohio) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 357-360 Sponsored by NASA (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19231*# Washington Univ., Seattle. Dept. of Astronomy.
A LAMBDA 1400 SPECTROPHOTOMETRIC CENSUS OF THE ORION BELT REGION
Douglas N. Brown and Steven N. Shore (New Mexico Inst. of Mining and Technology, Socorro) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 365-368 (For primary document see N87-19150 11-88)
(Grants NAG5-179; NAG5-357)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19232# Kiel Univ. (West Germany). Inst. fuer Theoretische Physik und Sternwarte.
ULTRAVIOLET SPECTROSCOPY OF THE HYDROGEN-DEFICIENT STAR HD 144941: THE ENERGY DISTRIBUTION AND THE STELLAR WIND
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N87-19233# Tuebingen Univ. (West Germany). Inst. fuer Astronomie.
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N87-19235# Observatoire de Paris (France).
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V. Doazan and R. N. Thomas (Radiophysics, Inc., Boulder, Colo.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 381-383 (For primary document see N87-19150 11-88)
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N87-19236# California Univ., Los Angeles. Dept. of Astronomy.
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N87-19237# University Coll., London (England). Dept. of Physics and Astronomy.
SEARCH FOR LINE PROFILE VARIABILITY IN HD 96548 (WN 8+?) AND HD 93131 (WN7ABS)
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N87-19238# Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Astronomia.
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Gloria Koenigsberger *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 393-394 (For primary document see N87-19150 11-88)
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N87-19239# Indiana Univ., Indianapolis.
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N87-19243# Michigan Univ., Dearborn.
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N87-19247# European Space Agency. ESA Tracking Station, Madrid (Spain). IUE Observatory.
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N87-19251# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Astronomy.
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H. Nussbaumer *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 447-450 (For primary document see N87-19150 11-88)
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N87-19252# Milan Univ. (Italy). Dept. of Physics.
FAR UV OBSERVATIONS OF LMC X-3, AN X-RAY BINARY CONTAINING A BLACK HOLE
A. Treves, T. Belloni, L. Chiappetti (Consiglio Nazionale delle Ricerche, Milan, Italy), S. Cristiani (European Southern Observatory, La Silla, Chile), R. Falomo (Osservatorio Astronomico, Padova, Italy), L. Maraschi, E. G. Tanzi (Consiglio Nazionale delle Ricerche, Milan, Italy), and M. vanderKlis (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 451-453 (For primary document see N87-19150 11-88)
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N87-19254# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Astrofisica.
X-RAY, ULTRAVIOLET AND OPTICAL MONITORING OF THE X-RAY/BE TRANSIENT SYSTEM A 0535+26/HDE 245770
F. Giovannelli, E. L. vanDessel (Belgian Royal Observatory, Brussels), M. Burger (Vrije Universiteit, Brussels, Belgium), C. deLoore, C. Bartolini (Bologna Univ., Italy), A. Guarnieri, A. Piccioni, I. N. Golynskaya (Academy of Sciences, USSR, Moscow), V. G. Kurt, T. A. Mizyakina et al *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 459-461 (For primary document see N87-19150 11-88)
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N87-19255# Armagh Observatory (Northern Ireland).
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N87-19256*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. Dept. of Astrophysics.
IUE OBSERVATIONS OF THE DWARF NOVAE OY CAR IN SUPEROUTBURST
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N87-19257# University Coll., London (England). Dept. of Physics and Astronomy.
ULTRAVIOLET SPECTROSCOPY OF THE X-RAY BINARY HZ HER/HER X-1
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N87-19259# Southampton Univ. (England). Dept. of Physics.
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N87-19262*# Arizona Univ., Tucson. Lunar and Planetary Lab.
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N87-19263# Imperial Coll. of Science and Technology, London (England). Astrophysics Group.
MAGNITUDES OF SELECTED CENTRAL STARS OF PLANETARY NEBULAE
N. A. Walton, N. K. Reay, S. R. Pottasch (Groningen Rijksuniversiteit, Netherlands), and P. D. Atherton *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 497-501 Sponsored by UK Science and Engineering Research Council (For primary document see N87-19150 11-88)
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N87-19264# Science Research Council, Chilton (England). Rutherford Appleton Lab.
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G. Ford and D. J. Stickland *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 502-504 (For primary document see N87-19150 11-88)
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N87-19265# Science Research Council, Chilton (England). Rutherford Appleton Lab.
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N87-19267# European Southern Observatory, Garching (West Germany).
OBSERVATIONS OF ACTIVE GALACTIC NUCLEI WITH IUE AND COMPARISON WITH X-RAY DATA
M. H. Ulrich *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 523-532 (For primary document see N87-19150 11-88)
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N87-19268# University Coll., London (England).
THE ULTRAVIOLET ASTRONOMY MISSION - LYMAN
R. Wilson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 533-536 (For primary document see N87-19150 11-88)
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N87-19270# Bonn Univ. (West Germany). Sternwarte.
REFLECTION NEBULAE OBSERVED WITH THE IUE (REVIEW)
Klass S. deBoer *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 551-554 (For primary document see N87-19150 11-88)
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N87-19271*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IUE STUDY OF THE VERY LOCAL INTERSTELLAR MEDIUM
R. C. Henry (Johns Hopkins Univ., Baltimore, Md.), J. Murthy, H. W. Moos, W. B. Landsman, J. L. Linsky (Joint Inst. for Lab. Astrophysics, Boulder, Colo.), A. Vidal-Madjar (Institut d'Astrophysique, Paris, France), and C. Gry (European Space Agency. ESA Tracking Station, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 555-558 Sponsored by NASA (For primary document see N87-19150 11-88)
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N87-19273# Queens Univ., Belfast (Northern Ireland). Dept. of Applied Mathematics and Theoretical Physics.
IUE AND OPTICAL STUDIES OF NEARBY INTERSTELLAR GAS
F. P. Keenan, B. Bates, and M. G. Catney *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 565-568 Sponsored by UK Science and Engineering Research Council (For primary document see N87-19150 11-88)
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N87-19282# University Coll., London (England). Dept. of Physics and Astronomy.
THE ULTRAVIOLET CONTINUUM OF QUASARS
P. T. OBrien, P. M. Gondhalekar (Science Research Council, Chilton, England), and R. Wilson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 601-604 (For primary document see N87-19150 11-88)
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N87-19284# Space Telescope Science Inst., Baltimore, Md.
HIGH SIGNAL-TO-NOISE SPECTRA OF TWO INTERMEDIATE REDSHIFT QUASARS
A. L. Kinney, P. J. Huggins, A. E. Glassgold, and J. N. Bregman *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 610-612 (For primary document see N87-19150 11-88)
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N87-19285# Milan Univ. (Italy). Dept. of Physics.
UV AND OPTICAL OBSERVATIONS OF 3C120 IN TWO DIFFERENT STATES
L. Maraschi, L. Chiappetti (Consiglio Nazionale delle Ricerche, Milan, Italy), J. Danziger (European Southern Observatory, Garching, West Germany), R. Falomo (Osservatorio Astronomico, Padova, Italy), E. G. Tanzi (Consiglio Nazionale delle Ricerche, Milan, Italy), and A. Treves *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 613-615 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19286# Consiglio Nazionale delle Ricerche, Milan (Italy).
UV AND OPTICAL VARIABILITY OF THE LOW LUMINOSITY QUASAR PG 1351+64
E. G. Tanzi, R. Falomo (Osservatorio Astronomico, Padova, Italy), M. A. Malkan (California Univ., Los Angeles), L. Maraschi (Milan Univ., Italy), E. Mediavilla, and A. Treves *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 617-619 (For primary document see N87-19150 11-88)
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N87-19287*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
SEVEN YEARS OF IUE OBSERVATIONS OF THE BL LACERTAE OBJECT PKS 2155-304
C. M. Urry *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 621-625 (For primary document see N87-19150 11-88)
(Grant NAG5-495)
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N87-19288# Royal Greenwich Observatory, Herstmonceux (England).
THE SPECTRUM OF THE BROAD ABSORPTION LINE QSO PG 0946+310 FROM 550 TO 4250 A
Max Pettini and Alec Boksenberg *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 627-631 (For primary document see N87-19150 11-88)
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N87-19289*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE Mg II LINE PROFILE IN THE SEYFERT GALAXY NGC 4151: A NEW OUTFLOWING COMPONENT
Kieron J. Leech (Sussex Univ., Brighton, England), M. V. Penston (Royal Greenwich Observatory, Herstmonceux, England), M. A. J. Snijders, and T. Gull *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 633-640 Sponsored by NASA and NC Science and Engineering Research Council (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03A

N87-19290# California Univ., Los Angeles. Dept. of Astronomy.
NEW ACCRETION DISK MODELING OF ACTIVE GALACTIC NUCLEI AND QUASARS
Wei-Hsin Sun and Matthew A. Malkan *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 641-644 (For primary document see N87-19150 11-88)
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N87-19291# European Space Agency. ESA Tracking Station, Madrid (Spain). IUE Observatory.

A DETAILED STUDY OF THE CIV1550 LINE PROFILE AND ADJACENT SPECTRAL FEATURES IN NGC4151 FROM 1978 UP TO 1983
J. Clavel, A. Altamore (Osservatorio Astronomico, Rome, Italy), A. Boksenberg (Royal Greenwich Observatory, Hailsham, England), G. E. Bromage (Science Research Council, Chilton, England), A. Elvius (Stockholm Observatory, Sweden), D. Pelat (Observatoire de Paris-Meudon, France), M. V. Penston (Royal Greenwich Observatory, Hailsham, England), G. C. Perola (Osservatorio Astronomico, Rome, Italy), M. A. J. Snijders (Royal Greenwich Observatory, Hailsham, England), and M. H. Ulrich (European Southern Observatory, Garching, West Germany) *In its* Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 645-648 (For primary document see N87-19150 11-88)
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N87-19292# China Scientific and Technical Univ., Hofei. Center for Astrophysics.
AN ARCHIVAL STUDY OF IUE OBSERVATIONS OF LOW REDSHIFT QUASARS
F. H. Cheng, A. L. Kinney (Space Telescope Science Inst., Baltimore, Md.), and L. Z. Fang *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 649-652 Sponsored in part by NASA, IAU and Dr. Fuhua Huang (For primary document see N87-19150 11-88)
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N87-19293*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE SPACE TELESCOPE IMAGING SPECTROGRAPH
Theodore R. Gull *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 653-659 (For primary document see N87-19150 11-88)
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N87-19294# Observatoire de Strasbourg (France).
IUE LOW-DISPERSION SPECTRA REFERENCE ATLAS. VOLUME 2: PECULIAR STARS
A. Heck, D. Egret, B. J. M. Hassall (Oxford Univ., England), C. Jaschek, M. Jaschek, and A. Talavera (European Space Agency. ESA Tracking Station, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 661-664 (For primary document see N87-19150 11-88)
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N87-19295# Bonn Univ. (West Germany). Sternwarte.
LIGHT SCATTERING IN THE IUE TELESCOPE
Klass S. deBoer and Angelo Cassatella (European Space Agency. ESA Tracking Station, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 665-667 (For primary document see N87-19150 11-88)
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N87-19296*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CORRECTING OBSERVED STELLAR LYMAN ALPHA PROFILES FOR THE EFFECTS OF INTERSTELLAR ABSORPTION AND GEOCORONAL EMISSION
J. E. Neff (Joint Inst. for Lab. Astrophysics, Boulder, Colo.), J. L. Linsky, W. B. Landsman, and K. G. Carpenter *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 669-672 (For primary document see N87-19150 11-88)
(Contract NAS5-26409; Grant NAG5-82)
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N87-19297*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
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Jaylee M. Mead, Lee E. Brotzman, and Yoji Kondo *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 675-677 (For primary document see N87-19150 11-88)
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N87-19299# Space Telescope Science Inst., Baltimore, Md.
ULTRAVIOLET STANDARD STARS FOR CALIBRATION OF THE HUBBLE SPACE TELESCOPE Progress Report
J. C. Blades, A. Nota, R. C. Bohlin, A. V. Holm, A. W. Harris (European Space Agency. ESA Tracking Station, Madrid, Spain), and C. Gry *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 683-685 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19300# Observatoire de Paris-Meudon (France).
THE ULTRAVIOLET TO INFRARED CONTINUUM OF NARROW EMISSION LINE ACTIVE GALAXIES
C. Boisson and F. Durret (Institut d'Astrophysique, Paris, France) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 687-689 (For primary document see N87-19150 11-88)
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N87-19303# European Space Agency. ESA Tracking Station, Madrid (Spain).
AN ULTRAVIOLET ANALYSIS OF THE PECULIAR GALAXY NGC 5253
R. Gonzalez-Riestra, M. Rego (Universidad Complutense, Madrid, Spain), and J. Zamorano *In its* Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 697-699 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19304# European Space Agency. ESA Tracking Station, Madrid (Spain).
OPTICAL AND UV SPECTROPHOTOMETRY OF A NORMAL SEYFERT 1: NGC5548
W. Wamsteker, P. M. Rodriguez, J. Clavel, A. Cassatella, A. Talavera, C. Gry, R. Gilmozzi, C. Lloyd, H. Netzer (Wise Observatory, Tel Aviv, Israel), B. Wills (Texas Univ., Austin) et al *In its* Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 701-703 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19305# Liege Univ. (Belgium). Inst. d'Astrophysique.
MULTIFREQUENCY OBSERVATIONS FOR THE SEYFERT 2: NGC3393
A. Diaz, W. Wamsteker (European Space Agency. ESA Tracking Station, Madrid, Spain), and A. Prieto (Universidad Complutense, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 705-708 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19306# Science Research Council, Chilton (England). Rutherford Appleton Lab.
VARIABILITY OF EMISSION LINES IN QUASAR SPECTRA: Q0405-123 AND Q1202+281
P. M. Gondhalekar, P. T. OBrien (University Coll., London, England), and R. Wilson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 711-714 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19307# Science Research Council, Chilton (England). Rutherford Appleton Lab.

ULTRAVIOLET LIGHT CURVE OF THE DOUBLE QUASAR QO957+561, A,B AND DETERMINATION OF THE HUBBLE CONSTANT
P. M. Gondhalekar, R. Wilson (University Coll., London, England), A. K. Dupree (Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.), and B. F. Burke (Massachusetts Inst. of Tech., Cambridge) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 715-717 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N87-19316 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
DISTANCES, LUMINOSITIES, AND SHELL STRUCTURES OF OH/IR STARS
J. Herman (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) and H. J. Habing Sep. 1986 19 p Presented at a Workshop on the Late Stages of Stellar Evolution, Calgary, Canada, 2-5 Jun. 1986 Submitted for publication
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It is shown that geometrical distances to OH/IR stars, derived from phase lag experiments and maps of the OH brightness distribution, from IRAS are good to 20%. The main contribution to the uncertainty comes from errors in the phase lag radii. Once the phase lags are known with an accuracy less than 10% it will become necessary to look in detail into the structure of the masing shells in order to improve on the distances. The luminosities of OH/IR stars lie in the range 1000 to 10,000 solar luminosities, a slight extension of the range for classical Mira variables. Stars with improbably low or high values of the luminosity are found. The most likely explanation is the uncertainty in the applied correction for interstellar extinction and the often unknown time variation in bolometric magnitude. Also, the sample may contain a few bright Supergiants. ESA

N87-19317 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
CONSTRAINTS ON THE MASS-RADIUS RELATION OF THE NEUTRON STAR IN 4U 1746-37/NGC 6441
M. Sztjano, M. Y. Fujimoto, J. vanParadijs (Amsterdam Univ., Netherlands), W. D. Vacca (Colorado Univ., Boulder), W. H. Lewin (Massachusetts Inst. of Tech., Cambridge), W. Penninx, and J. Truemper Sep. 1986 40 p Submitted for publication
(MPE-Preprint-69; ETN-87-99326) Copyright. Avail: Issuing Activity

Twelve hours of continuous EXOSAT observations (1985 September 9-10) of 4U 1746-37, located in the globular cluster NGC 6441, were analyzed. Two almost identical X-ray bursts, separated by 8h27m, were detected. The evolution of the bursts indicates that they are type 1 (thermonuclear) bursts, which during their peaks show radius expansion of the neutron star photosphere. Using the optical distance range (6.8 to 11.1 kpc), and allowing for anisotropy in the burst emission, constraints on the mass-radius relation for the neutron star in 4U 1746-37 were derived. If the neutron star has a canonical mass of 1.4 solar mass, the observed burst fluxes have to be reduced as a result of anisotropy of the burst emission by a factor at least 1.3 to 2.2 (depending on the composition of the neutron star surface). Results are consistent with the very soft and intermediately stiff equations of state, and argue against the very stiff equations of state for neutron star matter proposed by Pandharipande and Smith (1975). ESA

N87-19318*# Atmospheric and Environmental Research, Inc., Cambridge, Mass.
COMETARY ATMOSPHERES: MODELING THE SPATIAL DISTRIBUTION OF OBSERVED NEUTRAL RADICALS Annual Report, 1 Jun. 1985 - 31 Aug. 1986
Michael R. Combi Dec. 1986 31 p
(Contract NASw-3950)
(NASA-CR-180217; NAS 1.26:180217) Avail: NTIS HC A03/MF A01 CSCL 03B

Progress during the second year of a program of research on the modeling of the spatial distributions of cometary radicals is discussed herein in several major areas. New scale length laws for cometary C2 and CN were determined which explain that the previously-held apparent drop of the C2/CN ratio for large heliocentric distances does not exist and that there is no systematic variation. Monte Carlo particle trajectory model (MCPTM) analysis of sunward and anti-sunward brightness profiles of cometary C2 was completed. This analysis implies a lifetime of 31,000 seconds for the C2 parent and an ejection speed for C2 of approximately 0.5 km/sec upon dissociation from the parent. A systematic reanalysis of published C3 and OH data was begun. Preliminary results find a heliocentric distance dependence for C3 scale lengths with a much larger variation than for C2 and CN. Scale lengths for OH are generally somewhat larger than currently accepted values. The MCPTM was updated to include the coma temperature. Finally, the collaborative effort with the University of Arizona programs has yielded some preliminary CCD images of Comet P/Halley. Author

N87-19319# Brookhaven National Lab., Upton, N. Y. Physics Dept.
LATE STAGES OF MASSIVE STAR EVOLUTION AND NUCLEOSYNTHESIS
Kenichi Nomoto and Masa-aki Hashimoto 1986 20 p Presented at the Early Universe and Its Evolution Conference, Erice, Italy, 3 Apr. 1986
(Contract DE-AC02-76CH-00016)
(DE87-001367; BNL-38508; CONF-8604236-3) Avail: NTIS HC A02/MF A01

The evolution of massive stars in the range of 8 to 25 solar masses is reviewed. The effect of electron degeneracy on the gravothermal nature of stars is discussed. Depending on the stellar mass, the stars form three types of cores, namely, non-degenerate, semi-degenerate, and strongly degenerate. The evolution for these cases is quite distinct from each other and leads to the three different types of final fate. It is suggested that our helium star model, which is equivalent to a 25 solar mass star, will form a relatively small mass iron core despite the faster C-12 (alpha, gamma) O-16 reaction. DOE

N87-19320# Los Alamos National Lab., N. Mex.
EVOLUTION OF VARIABLE STARS
S. A. Becker Aug. 1986 12 p Presented at the Stellar Pulsation Conference, Los Alamos, N. Mex., 1 Aug. 1986
(Contract W-7405-eng-36)
(DE87-000172; LA-UR-86-3387; CONF-8608130-1) Avail: NTIS HC A02/MF A01

Throughout the domain of the H R diagram lie groupings of stars whose luminosity varies with time. These variable stars can be classified based on their observed properties into distinct types such as Beta Cephei stars, delta Cephei stars, and Miras, as well as many other categories. The underlying mechanism for the variability is generally felt to be due to four different causes: geometric effects, rotation, eruptive processes, and pulsation. In this review the focus will be on pulsation variables and how the theory of stellar evolution can be used to explain how the various regions of variability on the H R diagram are populated. To this end a generalized discussion of the evolutionary behavior of a massive star, an intermediate mass star, and a low mass star will be presented. DOE

N87-19153# Oxford Univ. (England). Dept. of Theoretical Physics.

CHROMOSPHERES OF COOL STARS
C. Jordan *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 17-13 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19154# Lowell Observatory, Flagstaff, Ariz. Planetary Research Center.
COMETS P/GIACOBINI-ZINNER AND P/HALLEY AT HIGH DISPERSION
David G. Schleicher and Michael F. AHearn (Maryland Univ., College Park) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 31-33 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19155*# National Aeronautics and Space Administration, Washington, D.C.
ULTRAVIOLET SPECTROPHOTOMETRY OF COMET GIACOBINI-ZINNER DURING THE ICE ENCOUNTER
Michael F. AHearn (Maryland Univ., College Park), Lucy A. McFadden, Paul D. Feldman (Johns Hopkins Univ., Baltimore, Md.), Hermann Boehnhardt (Remeis Sternwarte, Bamberg, West Germany), Juergen Rahe, Michael Festou (Observatoire de Besancon, France), John C. Brandt (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.), Stephen P. Maran, Malcom B. Niedner, Andrew M. Smith et al *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 35-38 (For primary document see N87-19150 11-88)
(Grants NAG5-252; NsG-5393)
Avail: NTIS HC A99/MF E03 CSCL 03B

N87-19156*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IUE OBSERVATIONS OF COMET HALLEY: EVOLUTION OF THE UV SPECTRUM BETWEEN SEPTEMBER 1985 AND JUNE 1986
P. D. Feldman (Johns Hopkins Univ., Baltimore, Md.), M. C. Festou (Observatoire de Besancon, France), M. F. AHearn (Maryland Univ., College Park), C. Arpigny (Liege Univ., Belgium), P. S. Butterworth, C. B. Cosmovici (Consiglio Nazionale delle Ricerche, Frascati, Italy), A. C. Danks (Michigan State Univ., East Lansing), R. Gilmozzi (European Space Agency. ESA Tracking Station, Madrid, Spain), W. M. Jackson (California Univ., Davis), L. A. McFadden (Maryland Univ., College Park) et al *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 39-42 (For primary document see N87-19150 11-88)
(Grants NsG-5393; NAG5-252)
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N87-19160# Hawaii Univ., Honolulu. Inst. for Astronomy.
ROTATION-ACTIVITY RELATIONS FOR LATE-TYPE STARS: WHERE DO WE STAND NOW?
Theodore Simon *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 53-56 (For primary document see N87-19150 11-88)
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N87-19162# Catania Astrophysical Observatory (Italy).
CHROMOSPHERE EMISSION IN LATE MAIN SEQUENCE STARS OF DIFFERENT MASSES AND AGES
E. Marilli, S. Catalano (Catania Univ., Italy), and C. Trigilio *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 61-64 Sponsored by the Italian Ministero della Publica Istruzione (For primary document see N87-19150 11-88)
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N87-19165# Bologna Univ. (Italy). Dipt. Astronomia.
EFFECTIVE TEMPERATURE, GRAVITY AND METALLICITY OF POPULATION 2 STARS
C. Cacciari, M. L. Malagnini (Trieste Univ., Italy), C. Morossi (Osservatorio Astronomico, Trieste, Italy), and L. Rossi (Consiglio Nazionale delle Ricerche, Frascati, Italy) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 75-78 (For primary document see N87-19150 11-88)
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N87-19166*# Vanderbilt Univ., Nashville, Tenn.
RAPIDLY ROTATING SINGLE LATE-TYPE GIANTS: NEW FK COMAE STARS?
Francis C. Fekel *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 79-81 Sponsored by NASA (For primary document see N87-19150 11-88)
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N87-19167*# Maryland Univ., College Park. Astronomy Program.
THE TEMPERATURES OF VERY METAL-POOR SUBDWARFS
R. A. Bell *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 83-85 (For primary document see N87-19150 11-88)
(Grants NAG5-589; NSF AST-80-19570)
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N87-19168# Oslo Univ. (Norway). Inst. of Theoretical Astrophysics.
THE UNUSUAL ROTATIONAL MODULATION OF THE UV RADIATION FROM THE SPOTTED FLARE STAR EV LAC
B. N. Andersen, O. Kjeldseth-Moe, and B. R. Pettersen *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 87-90 (For primary document see N87-19150 11-88)
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N87-19172*# Colorado Univ., Boulder. Center for Astrophysics and Space Astronomy.
ACTIVITY IN WARM STARS: IUE OBSERVATIONS OF EARLY F DWARFS
Frederick M. Walter and Jeffrey L. Linsky *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 103-106 (For primary document see N87-19150 11-88)
(Contract NAS5-26409; Grant NAG5-429)
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N87-19174# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
CHROMOSPHERIC-CORONAL ACTIVITY AT HIGH SATURATED LEVELS
Osmi Vilhu, James E. Neff, and Frederick M. Walter (Colorado Univ., Boulder) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 113-116 (For primary document see N87-19150 11-88)
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N87-19176# Tuebingen Univ. (West Germany). Inst. fuer Astronomie.
THE OUTER ATMOSPHERES OF FK COMAE STARS
M. Grewing and L. Bianchi (Osservatorio Astronomico, Turin, Italy) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 121-123 (For primary document see N87-19150 11-88)
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N87-19177# National Center for Atmospheric Research, Boulder, Colo. High Altitude Observatory.
ROTATIONAL MODULATION OF THE WIND OF THE PMS STAR AB AUR: NEW OBSERVATIONS IN C IV AND Mg II

C. Catala, F. Praderie (Observatoire de Paris-Meudon, France), and P. Felenbok *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 125-128 Sponsored by NSF (For primary document see N87-19150 11-88)
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N87-19179# University Coll., Cardiff (Wales). Dept. of Applied Mathematics and Astronomy.
SULPHUR COMPOUNDS IN COMETS
K. S. KrishnaSwamy (Tata Inst. of Fundamental Research, Bombay, India) and M. W. Wallis *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 133-136 Sponsored by UK Science and Engineering Research Council (For primary document see N87-19150 11-88)
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AN EPISODE OF MASS EXPULSIONS FROM THE M-DWARF FLARE STAR EV LACERTAE?
C. W. Ambruster, B. R. Pettersen (Oslo Univ., Norway), S. Hawley (Texas Univ., Austin), L. A. Coleman (Arkansas Univ., Fayetteville), and W. H. Sandmann (Harvey Mudd Coll., Claremont, Calif.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 137-140 (For primary document see N87-19150 11-88)
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N87-19182*# Indiana Univ., Bloomington. Dept. of Astronomy.
THE OUTER ATMOSPHERES OF COOL M GIANTS: HIGH-DISPERSION ULTRAVIOLET SPECTRA OF RHO PER, 2 CEN, AND HER
Joel A. Eaton and Hollis R. Johnson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 145-148 (For primary document see N87-19150 11-88)
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N87-19186*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
WHERE DO FLARES OCCUR IN RS CVN SYSTEMS? ANALYSIS OF THE OCTOBER 3, 1981 FLARE ON V711 TAU = HR 1099 OBSERVED BY IUE
J. L. Linsky, J. E. Neff, B. D. Gross, T. Simon, A. D. Andrews (Armagh Observatory, Northern Ireland), and M. Rodono (Catania Astrophysical Observatory, Italy) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 161-164 Sponsored by CNR, Max-Planck Inst. and NATO (For primary document see N87-19150 11-88)
(Contract NAS5-26409; Grant NAG5-82)
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N87-19187*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROTATIONAL MODULATION IN IUE SPECTRA OF COOL DWARF CHROMOSPHERES: DATA ANALYSIS AND PERIOD SEARCH TECHNIQUES
B. Altner (Applied Research Corp., Landover, Md.), A. S. Endal, and K. L. Hallam *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 165-168 (For primary document see N87-19150 11-88)
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N87-19189*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
CHROMOSPHERIC AND TRANSITION REGION STRUCTURE OF THE HERBIG EMISSION STARS HR 5999 AND BN ORI
A. Brown, H. R. E. TjinaDjie (Amsterdam Univ., Netherlands), and P. S. The *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 173-176 (For primary document see N87-19150 11-88)
(Grant NAG5-82)
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N87-19191# Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.
FLARES AND ACTIVE SECTORS ON YY GEMINORUM
S. L. Baliunas, J. C. Raymond, and J. G. Loeser *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 181-183 (For primary document see N87-19150 11-88)
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N87-19192# Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.
THE SURFACE AND ATMOSPHERIC STRUCTURE OF THE ACTIVE G8 III STAR FF AQUAR 2
S. L. Baliunas, J. G. Loeser, J. C. Raymond, E. F. Guinan (Villanova Univ., Pa.), and J. D. Dorren (Pennsylvania Univ., Philadelphia) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 185-187 (For primary document see N87-19150 11-88)
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N87-19193# Oxford Univ. (England). Dept. of Theoretical Physics.
THE OUTER ATMOSPHERES OF LATE-TYPE GIANT STARS
P. G. Judge *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 189-192 (For primary document see N87-19150 11-88)
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N87-19194# STI, Inc., Lanham, Md.
THE STELLAR WINDS OF K AND EARLY M GIANTS: EVIDENCE FOR A SUBCLASS WITH ABNORMALLY HIGH EXPANSION VELOCITIES
S. A. Drake *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 193-196 (For primary document see N87-19150 11-88)
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N87-19195*# Villanova Univ., Pa.
EVIDENCE OF LARGE-SCALE STRUCTURES IN THE ATMOSPHERE OF THE ACTIVE K-DWARF COMPONENT OF V471 TAURI
E. F. Guinan, S. W. Wacker, S. L. Baliunas (Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.), J. G. Loeser, and J. C. Raymond *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 197-200 (For primary document see N87-19150 11-88)
(Grants NAG5-382; NAG5-87)
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N87-19196*# Pennsylvania Univ., Philadelphia. Dept. of Astronomy and Astrophysics.
THE LONG-TERM EVOLUTION OF CHROMOSPHERIC, TRANSITION-REGION, AND STARSPOT ACTIVITY IN THE RS CVN SYSTEM V711 TAURI
J. D. Dorren, E. F. Guinan (Villanova Univ., Pa.), and S. W. Wacker *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 201-204 Sponsored by NASA Goddard Space Flight Center (For primary document see N87-19150 11-88)
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N87-19199*# Colorado Univ., Boulder. Center for Astrophysics and Space Astronomy.
Mg II EMISSION FROM SHOCK WAVES IN MIRA VARIABLES
Edward W. Brugel, Lee Anne Willson (Iowa State Univ. of Science and Technology, Ames), and Robert Cadmus (Grinnell Coll., Iowa) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep.

1986 p 213-216 (For primary document see N87-19150 11-88)
(Contract NAS5-28731; Grant NAG5-350)
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N87-19203*# Armagh Observatory (Northern Ireland).
IUE SPECTRA OF FLARES ON AU MIC
C. J. Butler, M. Rodono (Catania Astrophysical Observatory, Italy), and J. L. Linsky (Joint Inst. for Lab. Astrophysics, Boulder, Colo.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 229-232 (For primary document see N87-19150 11-88)
(Grants NAG5-82; CNR-82-01382-02; NATO-No-386/84)
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N87-19206# Technische Univ., Munich (West Germany). Sternwarte.
MASS LOSS OF HOT LUMINOUS STARS
R. P. Kudritzki, A. Pauldrach, and J. Puls *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 247-258 (For primary document see N87-19150 11-88)
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N87-19207*# Wisconsin Univ., Madison. Washburn Observatory.
THE GALACTIC CORONA
Blair D. Savage *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 259-265 (For primary document see N87-19150 11-88)
(Grant NAG5-186)
Avail: NTIS HC A99/MF E03 CSCL 03B

N87-19208# La Plata Univ. (Argentina). Facultad de Ciencias Astronomicas y Geofisicas.
EVOLUTION OF INTERACTING BINARIES
Jorge Sahade *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 267-274 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19211*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE MASSIVE STAR CONTENT OF BLUE IRREGULAR GALAXIES
S. A. Lamb, D. A. Hunter (Lowell Observatory, Flagstaff, Ariz.), and J. S. Gallagher, III *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 283-285 (For primary document see N87-19150 11-88)
(Grant NAG5-404)
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N87-19212# Heidelberg Univ. (West Germany). Inst. fuer Theoretische Astrophysik.
WINDS FROM CENTRAL STARS OF PLANETARY NEBULAE
G. Bombeck, J. Koeppen, and U. Bastian *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 287-290 Sponsored by Deutsche Forschungsgemeinschaft (For primary document see N87-19150 11-88)
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N87-19213*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE TERMINAL VELOCITIES OF WINDS IN CENTRAL STARS OF PLANETARY NEBULAE
Sara R. Heap *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 291-294 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03B

N87-19218# Institut d'Astrophysique, Paris (France).
STAR 40 CNC: A VEGA ANALOG?
Michele Gerbaldi and Rubens Freire-Ferrero (Observatoire de Strasbourg, France) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 311-314 (For primary document see N87-19150 11-88)
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N87-19220# Observatoire de Strasbourg (France).
THE INTERSTELLAR ABSORPTION IN THE DIRECTION OF HD 119921
R. Freire-Ferrero and R. Ferlet (Institut d'Astrophysique, Paris, France) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 319-322 (For primary document see N87-19150 11-88)
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N87-19221# Royal Observatory, Edinburgh (Scotland).
THE EXCITING STARS OF VERY LOW EXCITATION COMPACT NEBULAE IN THE LMC
K. Nandy, D. H. Morgan, and A. J. Willis (University Coll., London, England) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 323-325 (For primary document see N87-19150 11-88)
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N87-19222# Vrije Universiteit, Brussels (Belgium). Inst. of Astrophysics.
THE IONIZATION FRACTION OF C IV IN OB STARS
Ronny Blomme *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 327-330 (For primary document see N87-19150 11-88)
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N87-19223# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Astrofisica Spaziale.
MASS LOSS PROBLEMS IN CYG OB2 ASSOCIATION: THE PARTICULAR CASE OF NO. 8A STAR
F. Giovannelli, V. F. Polcaro, C. Bartolini (Bologna Univ., Italy), A. Guarnieri, and A. Piccioni *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 331-333 (For primary document see N87-19150 11-88)
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N87-19226# University Coll., London (England). Dept. of Physics and Astronomy.
THE STELLAR WINDS OF EARLY-TYPE STARS IN THE SMC
Raman K. Prinja *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 343-346 (For primary document see N87-19150 11-88)
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N87-19227# Queens Univ., Belfast (Northern Ireland). Dept. of Pure and Applied Physics.
A COMPARISON OF MODELS WITH OBSERVATIONS FOR DISCRETE ABSORPTION COMPONENTS IN SPECTRA OF MASS LOSING STARS
B. Bates, D. Halliwell, and M. Catney *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 347-351 Sponsored by UK Science and Engineering Research Council, and Northern Ireland Dept. of Education (For primary document see N87-19150 11-88)
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N87-19230*# New Mexico Inst. of Mining and Technology, Socorro. Dept. of Physics.
IUE OBSERVATIONS OF MAGNETICALLY CONTROLLED STEL-

LAR WINDS IN THE HELIUM PECULIAR STARS
Steven N. Shore and Douglas N. Brown (Washington Univ., Seattle) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 361-364 (For primary document see N87-19150 11-88)
(Grants NAG5-179; NAG5-357)
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N87-19234*# State Univ. of New York, Stony Brook. Astronomy Program.
CARBON AND NITROGEN IN B2 TO A2 MAIN-SEQUENCE STARS
Johannes Hardorp (State Univ. of New York, Stony Brook), Henryk Cugier, Anuradha Koratkar, and James Scott *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 377-380 (For primary document see N87-19150 11-88)
(Grant NAG5-555)
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N87-19240# Arizona Univ., Tucson. Lunar and Planetary Lab.
EFFECTIVE TEMPERATURES OF HOT WHITE DWARFS FROM IUE LYMAN ALPHA PROFILES
J. B. Holberg and F. Wesemael (Montreal Univ., Quebe) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 399-402 (For primary document see N87-19150 11-88)
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N87-19241*# Computer Sciences Corp., Greenbelt, Md.
THE LUMINOSITIES OF THE BINARY CEPHEIDS SU CYG, SU CAS AND W SGR
Nancy Remage Evans and Armando Arellano Ferro *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 403-404 Sponsored in part by a Helm Travel Grant, and the Canadian National Science and Engineering Research Council (For primary document see N87-19150 11-88)
(Contract NAS5-28749)
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N87-19242*# Computer Sciences Corp., Greenbelt, Md.
THE MASS OF THE CLASSICAL CEPHEID SU CYGNI
Nancy Remage Evans and C. Thomas Bolton (Toronto Univ., Downsview, Ontario) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 405-407 Sponsored in part by a Helm Travel Grant, and the Canadian National Science and Engineering Research Council (For primary document see N87-19150 11-88)
(Contract NAS5-28749)
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N87-19244# Comision Nacional de Investigacion del Espacio, Madrid. Grupos Cientificos.
BLUE STRAGGLER STARS IN THE ULTRAVIOLET
C. Morales Duran and L. Sabau Graziati *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 415-417 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19245*# Computer Sciences Corp., Beltsville, Md. Astronomy Program.
THE EVIDENCE FOR ASPECT DEPENDENT WINDS IN Be STARS
Carol A. Grady, Karen C. Bjorkman (Colorado Univ., Boulder), and Theodore P. Snow *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 419-422 (For primary document see N87-19150 11-88)
(Contract NAS5-25774; Grant NsG-5300)
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N87-19246*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE ENERGY DISTRIBUTIONS OF B SUPERGIANTS IN THE LARGE MAGELLANIC CLOUD
Edward L. Fitzpatrick *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 423-426 Sponsored in part by NASA and NSF (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19248# University Coll., London (England). Dept. of Physics and Astronomy.
REDSHIFT EVOLUTION OF INTERGALACTIC ABSORPTION CLOUDS
P. T. OBrien, P. M. Gondhalekar, and R. Wilson *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 435-438 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19249# Imad ad Dean, Inc., Bethesda, Md.
EMERGING PICTURE OF ACCRETION SHOCKS IN DETACHED BINARIES
Imad A. Ahmad and Robert D. Chapman (Executive Office of the President, Washington, D. C.) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 439-442 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19250*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE R AQUARII-JET AT UV AND RADIO WAVELENGTHS
A. G. Michalitsianos, M. Kafatos, and J. M. Hollis *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 443-446 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03B

N87-19253# Rome Univ. (Italy). Ist. Astronomico.
ULTRAVIOLET BEHAVIOR OF SS CYGNI IN QUIESCENCE AND IN OUTBURST
S. Gaudenzi, F. Giovannelli (Consiglio Nazionale delle Ricerche, Frascati, Italy), R. Lombardi, and R. Claudi *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 455-458 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19258*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ORBITAL VARIABILITY IN THE WIND OF THE MASSIVE X-RAY BINARY HD 153919/4U1700-37
Ian D. Howarth (University Coll., London, England), Godelieve Hammerschlag-Hensberge (Amsterdam Univ., Netherlands), and Timothy Kallman *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 475-477 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03 CSCL 03B

N87-19260# Science Research Council, Chilton (England). Rutherford Appleton Lab.
TIDALLY INDUCED MASS LOSS IN IOTA ORIONIS
D. J. Stickland, C. Lloyd, C. D. Pike, A. J. Willis, and I. D. Howarth *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 487-490 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19261# Chicago Univ., Ill. Dept. of Astronomy.
LIMITS ON THE LOCAL FLUFF FROM IUE Mg I DATA
P. C. Frisch, D. G. York, and J. R. Fowler *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 491-492 (For

primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19266*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE INTERSTELLAR MEDIUM
J. Michael Shull *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 511-522 Prepared in cooperation with National Bureau of Standards, Boulder, Colo. (For primary document see N87-19150 11-88)
(Grants NAG5-193; NSG-7128)
Avail: NTIS HC A99/MF E03 CSCL 03B

N87-19272# Catania Univ. (Italy). Osservatori Astrofisica.
EXTINCTION AND DUST IN THE ORION REGION
A. Magazzu, G. A. Baratta, and G. Strazzulla *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 559-562 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19274# Institut d'Astrophysique, Paris (France).
THE CIRCUMSTELLAR GAS AROUND BETA PICTORIS
A. M. Lagrange, R. Ferlet, and A. Vidal-Madjar *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 569-571 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19275# Science Research Council, Chilton (England). Rutherford Appleton Lab.
THE INTERSTELLAR ABUNDANCE OF THE VOLATILE ELEMENTS SULPHUR AND ZINC IN HIGH DENSITY SIGHT-LINES
A. W. Harris and J. M. Mas Hesse (Universidad Complutense, Madrid, Spain) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 573-576 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19276# Science Research Council, Chilton (England). Rutherford Appleton Lab.
THE CASE FOR DIFFUSE, COLLISIONALLY IONIZED INTERSTELLAR C IV AND SI IV BELOW Z = 1 kpc
Alan W. Harris and Gordon E. Bromage *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 577-580 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19277*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ELEMENTAL ABUNDANCE DETERMINATION IN GASEOUS NEBULAE FROM IUE LINES
Robert H. Rubin and B. Zuckerman (California Univ., Los Angeles) *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 581-583 (For primary document see N87-19150 11-88)
(Grant NAG5-710)
Avail: NTIS HC A99/MF E03 CSCL 03B

N87-19278# Florence Univ. (Italy). Dept. of Physics.
STATISTICAL ANALYSIS OF UV EXTINCTION CURVES TOWARDS OB ASSOCIATIONS
S. Aiello, B. Barsella (Pisa Univ., Italy), G. Chlewicki (Groningen Rijksuniversiteit, Netherlands), F. Ferrini (Pisa Univ., Italy), P. Patriarchi, and C. Sandi *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 585-588 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19279# Consiglio Nazionale delle Ricerche, Florence (Italy). Dept. of Physics.
A STUDY OF UV EXTINCTION TOWARDS OB ASSOCIATIONS AND STAR-FORMING REGIONS BASED ON IUE DATA
S. Aiello, B. Barsella (Pisa Univ., Italy), G. Chlewicki (Groningen Rijksuniversiteit, Netherlands), J. M. Greenberg (Leiden Univ., Netherlands), P. Patriarchi (Florence Univ., Italy), and M. Perinotto *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 589-592 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19280# University Coll., London (England). Dept. of Physics and Astronomy.
INTERSTELLAR 2200 A, A NEW CHARGE TRANSFER SOLUTION?
David J. Carnochan *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 593-596 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19281# Imperial Coll. of Science and Technology, London (England). Blackett Lab.
EVIDENCE FROM ULTRAVIOLET SPECTROSCOPY FOR STARBURSTS IN THE NUCLEI OF INTERACTING AND MERGING GALAXIES
R. D. Joseph, G. S. Wright, and A. H. Prestwich *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 597-600 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19283# Bowling Green State Univ., Ohio. Dept. of Physics and Astronomy.
INSIGHTS TO THE NATURE OF THE BLR IN SEYFERT-1 GALAXIES
Ronald E. Stoner and Roger L. Ptak *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 605-609 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19298# Osservatorio Astronomico, Trieste (Italy).
INTERSTELLAR C IV AND SI IV IN THE LOCAL INSTELLAR MEDIUM(?)
P. Molaro, G. Vladilo, and J. E. Beckman *In* European Space Agency, Paris, France. Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 678-682 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19301# Leicester Univ. (England). Dept. of Astronomy.
CONSTRAINTS ON VISCOSITY IN ACCRETION DISKS FROM UV VARIABILITY IN AGNS
Bozena Czerny and Michal Czerny *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 691-692 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

N87-19302# Leicester Univ. (England). Dept. of Astronomy.
UV EMISSION LINES IN GALACTIC NUCLEI: PREDICTIONS FROM THE DUELLING WIND MODEL
M. D. Smith and D. J. Raine *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 693-695 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N87-19321*# National Aeronautics and Space Administration, Washington, D.C.
AN OVERVIEW OF THE SOVIET VEGA BALLOON EXPERIMENT AND STUDIES OF THE ATMOSPHERE OF VENUS
R. Z. Sagdeev May 1986 116 p Transl. into ENGLISH Pisma v Astronomicheskiy Zhurnal (Moscow, USSR), v. 12, no. 1, 1986 p 5-95 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88516; NAS 1.15:88516) Avail: NTIS HC A06/MF A01 CSCL 03B

An overview of the VEGA probe to Venus is given, including a detailed examination of the balloon experiment to study the atmosphere of Venus. The areas of study include the ground network, the global network of radiotelescopes, meteorological measurements, the thermal structure of the Venus atmosphere in the middle cloud layer, atmospheric dynamics, and other results of the VEGA 1 and 2 experiments. Author

N87-19322*# National Aeronautics and Space Administration, Washington, D.C.
STATUS AND FUTURE OF LUNAR GEOSCIENCE
1986 63 p
(NASA-SP-484; NAS 1.21:484) Avail: SOD HC $4.25 as 033-000-00997-6; NTIS MF A01 CSCL 03B

The Moon is of special interest among the many and diverse bodies of the solar system because it serves as a scientific baseline for understanding the terrestrial planets, its origin is closely tied to the early history of the Earth, and its proximity permits a variety of space applications such as mining and establishment of bases and colonies. Data acquisition and analysis have enabled advances to be made and the remaining questions in many fields of lunar geoscience to be identified. The status and unresolved problems of lunar science are discussed. Immediate needs, new unmanned missions, and a return to the Moon (a lunar base) are examined. B.G.

N87-19323*# Missouri Univ., St. Louis. Dept. of Physics.
INTERANNUAL VARIABILITY OF MARS SOUTH POLAR CAP
Philip B. James, Klaus M. Malolepszy, and Leonard J. Martin (Lowell Observatory, Flagstaff, Ariz.) 1987 21 p
(Grants NAGw-742; NAGw-638)
(NASA-CR-180207; NAS 1.26:180207) Avail: NTIS HC A02/MF A01 CSCL 03B

Telescopic data on the twentieth century regressions of Mars' south polar cap were reexamined for evidence of interannual variability. Several regressions, particularly that of 1956, are found to differ significantly from the mean. The possibility of correlations with major dust storms is explored. Author

N87-19324*# Colorado Univ., Boulder. Lab. for Atmospheric and Space Physics.
THE BEHAVIOR OF WATER ON MARS Progress Report
Bruce M. Jakosky 25 Mar. 1987 6 p
(Grant NAGw-552)
(NASA-CR-180249; NAS 1.26:180249) Avail: NTIS HC A02/MF A01 CSCL 03B

The recent focus in Mars research was in the area of the seasonal behavior of water in the atmosphere, surface, and polar caps, and exchange of water between these reservoirs. Results of recent work is summarized. B.G.

N87-19325*# Arizona Univ., Tucson. Lunar and Planetary Lab.
HYDROGEN EMISSION FROM JUPITER: HYDROGEN EMISSION FROM SUNLIT ATMOSPHERE OF SATURN Semiannual Status Report
D. E. Shemansky and J. B. Holberg Apr. 1987 25 p
(Grant NAG5-560)
(NASA-CR-180245; NAS 1.26:180245) Avail: NTIS HC A02/MF A01 CSCL 03B

Successful IUE observations of the equatorial sunlit atmosphere of Jupiter and Saturn have been obtained. Spectra containing atomic and molecular hydrogen and solar reflection continuum emissions have been analyzed, with the purpose of determining the long term temporal behavior of the electroglow process. Quantitative estimates have been established for the first time using a model analysis of the short wavelength region of the spectrum. Both systems show varying degrees of long term variability in hydrogen emission rate, but the time scale is too short to determine whether there is a dependence on solar cycle activity. As part of the emission modeling program, a preliminary point source spreading function for the IUE SWP instrument has been established, suggesting a wavelength dependence in spectral line width different from previous analyses. Further IUE observations are planned for both Jupiter and Saturn. Author

N87-19326*# Observatoire de Paris (France).
MONODEUTERATED METHANE IN THE OUTER SOLAR SYSTEM. PART 3: ITS ABUNDANCE ON TITAN
C. deBergh, B. L. Lutz (Lowell Observatory, Flagstaff, Ariz.), T. Owen (State Univ. of New York, Stony Brook), and J. Chauville 1987 16 p
(Grant NsG-7499)
(NASA-CR-180254; NAS 1.26:180254) Avail: NTIS HC A02/MF A01 CSCL 03B

The 3 nu 2 band of CH3D has been detected in spectra of Titan recorded at 1.6 microns with the Fourier Transform Spectrometer (FTS) at the 4 m telescope of the Kitt Peak National Observatory (NOAO). We have obtained a value of the CH3D/CH4 mixing ratio of 6.6 (+6.6 or -3.3) x 10 to the -4 from a comparison between the observed Titan spectra and synthetic spectra. This value is approx. 2 times higher than the value measured on Uranus (de Bergh et al. 1986) and approx. 6 times higher than on Jupiter and on Saturn (Courtin et al. 1984; de Bergh et al. 1986). It corresponds to D/H of 1.65 (+1.65 or -0.8) x 10 the -4, nominally 8 times higher than the most commonly accepted value for the protosolar D/H = 2 x 10 to the -5 (Geiss and Reeves 1981). The value we find on Titan for D/H in methane is comparable to the D/H ratio measured in terrestrial H2O. Author

N87-19327*# California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
PHOTOCHEMICAL PRODUCTION OF H2SO4 AEROSOLS ON VENUS Final Technical Report, 1 Oct. 1983 - 31 Oct. 1986
L. Yung Yuk Oct. 1986 21 p
(Grant NAG2-267)
(NASA-CR-180256; NAS 1.26:180256) Avail: NTIS HC A02/MF A01 CSCL 03B

The quantum yields for producing O2(a (1 delta g)) and O2(b(1 sigma g +)) for the reaction, O + ClO yields Cl + O2, are summarized. Also included are results for other simple reactions capable of producing the singlet oxygen states. An episodic injection of SO2 into the upper atmosphere of Venus is considered as a possible explanation for the airglow values. B.G.

N87-19152*# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics and Astronomy.
THE IO TORUS AND THE JOVIAN MAGNETOSPHERE
P. D. Feldman *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 11-16 (For primary document see N87-19150 11-88)
(Grant NsG-5393)
Avail: NTIS HC A99/MF E03 CSCL 03B

N87-19157# State Univ. of New York, Stony Brook. Dept. of Earth and Space Sciences.
IUE OBSERVATIONS OF SATURN'S RINGS

R. Wagener and J. J. Caldwell *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 43-44 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N87-19328*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENERGETIC PHENOMENA ON THE SUN: THE SOLAR MAXIMUM MISSION FLARE WORKSHOP. PROCEEDINGS
Mukul Kundu, ed. (Maryland Univ., College Park) and Bruce Woodgate, ed. Dec. 1986 423 p Workshop held in Greenbelt, Md., 24-28 Jan. 1983, 9-14 Jun. 1983, and 13-17 Feb. 1984
(NASA-CP-2439; NAS 1.55:2439) Avail: NTIS HC A18/MF A01 CSCL 03B

The general objectives of the conference were as follows: (1) Synthesize flare studies after three years of Solar Maximum Mission (SSM) data analysis. Encourage a broader participation in the SMM data analysis and combine this more fully with theory and other data sources-data obtained with other spacecraft such as the HINOTORI, p78-1, and ISEE-3 spacecrafts, and with the Very Large Array (VLA) and many other ground-based instruments. Many coordinated data sets, unprecedented in their breadth of coverage and multiplicity of sources, had been obtained within the structure of the Solar Maximum Year (SMY). (2) Stimulate joint studies, and publication in the general scientific literature. The intended primary benefit was for informal collaborations to be started or broadened at the Workshops with subsequent publications. (3) Provide a special publication resulting from the Workshop. For individual titles, see N87-19329 through N87-19341.

N87-19329*# Saint Andrew's Univ. (Scotland).
MAGNETOHYDRODYNAMIC INSTABILITY
E. R. Priest, P. Cargill (Maryland Univ., College Park), T. G. Forbes (New Hampshire Univ., Durham), A. W. Hood, and R. S. Steinolfson (California Univ., Berkeley) *In* NASA. Goddard Space Flight Center Energetic Phenomena on the Sun. The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 14 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

There have been major advances in the theory of magnetic reconnection and of magnetic instability, with important implications for the observations, as follows: (1) Fast and slow magnetic shock waves are produced by the magnetohydrodynamics of reconnection and are potential particle accelerators. (2) The impulsive bursty regime of reconnection gives a rapid release of magnetic energy in a series of bursts. (3) The radiative tearing mode creates cool filamentary structures in the reconnection process. (4) The stability analyses imply that an arcade can become unstable when either its height or twist of plasma pressure become too great. Author

N87-19330*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PREFLARE MAGNETIC AND VELOCITY FIELDS
M. J. Hagyard (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.), V. Gaizauskas (Herzberg Inst. of Astrophysics, Ottawa, Ontario), G. A. Chapman (California State Univ., Fullerton), A. C. deLoach (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.), G. A. Gary, H. P. Jones, J. T. Karpen (Naval Research Lab., Washington, D. C.), M.-J. Martres (Observatoire de Paris, France), J. G. Porter (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.), B. Schmeider (Observatoire de Paris, France) et al *In its* Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 33 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

A characterization is given of the preflare magnetic field, using theoretical models of force free fields together with observed field structure to determine the general morphology. Direct observational evidence for sheared magnetic fields is presented. The role of this magnetic shear in the flare process is considered within the context of a MHD model that describes the buildup of magnetic energy, and the concept of a critical value of shear is explored. The related subject of electric currents in the preflare state is discussed next, with emphasis on new insights provided by direct calculations of the vertical electric current density from vector magnetograph data and on the role of these currents in producing preflare brightenings. Results from investigations concerning velocity fields in flaring active regions, describing observations and analyses of preflare ejecta, sheared velocities, and vortical motions near flaring sites are given. This is followed by a critical review of prevalent concepts concerning the association of flux emergence with flares Author

N87-19331*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CORONAL MANIFESTATIONS OF PREFLARE ACTIVITY
E. J. Schmahl (Maryland Univ., College Park), D. F. Webb (American Science and Engineering, Inc., Cambridge, Mass.), B. Woodgate, P. Waggett (GEC-Marconi Electronics Ltd., Chelmsford, England), R. Bentley (Mullard Space Science Lab., Dorking, England), G. Hurford (California Inst. of Tech., Pasadena), A. Schadee (Utrecht State Univ., Netherlands), J. Schrijver, R. Harrison (National Center for Atmospheric Research, Boulder, Colo.), and P. Martens *In its* Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 32 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

A variety of coronal manifestations of precursors or preheating for flares are discussed. Researchers found that almost everyone with a telescope sees something before flares. Whether an all-encompassing scenario will ever be developed is not at all clear at present. The clearest example of preflare activity appears to be activated filaments and their manifestations, which presumably are signatures of a changing magnetic field. But researchers have seen two similar eruptions, one without any evidence of emerging flux (Kundu et al., 1985) and the other with colliding poles (Simon et al., 1984). While the reconnection of flux is generally agreed to be required to energize a flare, the emergence of flux from below (at least on short timescales and in compact regions) does not appear to be a necessary condition. In some cases the cancelling of magnetic flux (Martin, 1984) by horizontal motions instead may provide the trigger (Priest, 1985) Researchers found similarities and some differences between these and previous observations. The similarities, besides the frequent involvement of filaments, include compact, multiple precursors which can occur both at and near (not at) the flare site, and the association between coronal sources and activity lower in the atmosphere (i.e., transition zone and chromosphere). Author

N87-19332*# Maryland Univ., College Park.
PARTICLE ACCELERATION
L. Vlahos (Maryland Univ., College Park), M. E. Machado (Observatorio Nacional de Fisica Cosmica, Argentina), R. Ramaty, R. J. Murphy, C. Alissandrakis (Athens Univ., Greece), T. Bai (Stanford Univ., Calif.), D. Batchelor, A. O. Benz (Eidgenoessische Technische Hochschule, Zurich, Switzerland), E. Chupp (New Hampshire Univ., Durham), D. Ellison (Maryland Univ., College Park) et al *In its* Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 57 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

Data is compiled from Solar Maximum Mission and Hinothori satellites, particle detectors in several satellites, ground based instruments, and balloon flights in order to answer fundamental questions relating to: (1) the requirements for the coronal magnetic

field structure in the vicinity of the energization source; (2) the height (above the photosphere) of the energization source; (3) the time of energization; (4) transistion between coronal heating and flares; (5) evidence for purely thermal, purely nonthermal and hybrid type flares; (6) the time characteristics of the energization source; (7) whether every flare accelerates protons; (8) the location of the interaction site of the ions and relativistic electrons; (9) the energy spectra for ions and relativistic electrons; (10) the relationship between particles at the Sun and interplanetary space; (11) evidence for more than one acceleration mechanism; (12) whether there is single mechanism that will accelerate particles to all energies and also heat the plasma; and (13) how fast the existing mechanisms accelerate electrons up to several MeV and ions to 1 GeV. Author

N87-19333*# California Univ., San Diego.
IMPULSIVE PHASE TRANSPORT
Richard C. Canfield, Francoise Bely-Dubau (Observatoire du Mont-Gros, Nice, France), John C. Brown (Glasgow Univ., Scotland), George A. Dulk (Colorado Univ., Boulder), A. Gordon Emslie (Alabama Univ., Huntsville), Shinzo Enome (Nagoya Univ., Japan), Alan H. Gabriel (Science Research Council, Chilton, England), Mukul R. Kundu (Maryland Univ., College Park), Donald Melrose (Sydney Univ., Australia), Donald F. Neidig (Air Force Geophysics Lab., Hanscom AFB, Mass.) et al *In* NASA. Goddard Space Flight Center Energetic Phenomena on the Sun: The solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 46 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

The transport of nonthermal electrons is explored. The thick-target electron beam model, in which electrons are presumed to be accelerated in the corona and typically thermalized primarily in the chromosphere and photosphere, is supported by observations throughout the electromagnetic spectrum. At the highest energies, the anisotropy of gamma-ray emission above 10 MeV clearly indicates that these photons are emitted by anisotropically-directed particles. The timing of this high-energy gamma-radiation with respect to lower-energy hard X-radiation implies that the energetic particles have short life-times. For collisional energy loss, this means that they are stopped in the chromosphere or below. Stereoscopic (two-spacecraft) observations at hard X-ray energies (up to 350 keV) imply that these lower-energy (but certainly nonthermal) electrons are also stopped deep in the chromosphere. Hard X-ray images show that, in spatially resolved flares whose radiation consists of impulsive bursts, the impulsive phase starts with X-radiation that comes mostly from the foot-points of coronal loops whose coronal component is outlined by microwaves. Author

N87-19334*# Naval Research Lab., Washington, D. C.
CHROMOSPHERIC EXPLOSIONS
G. A. Doschek, S. K. Antiochos, E. Antonucci (Turin Univ., Italy), C.-C. Cheng, J. L. Culhane (Mullard Space Science Lab., Dorking, England), G. H. Fisher (Lawrence Livermore National Lab., Calif.), C. Jordan (Oxford Univ., England), J. W. Leibacher (Kitt Peak National Observatory, Tucson, Ariz.), P. MacNeice (Science Research Council, Chilton, England), R. W. P. McWhirter et al *In* NASA. Goddard Space Flight Center Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 42 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

Three issues relative to chromospheric explosions were debated. (1) Resolved: The blue-shifted components of x-ray spectral lines are signatures of chromospheric evaporation. It was concluded that the plasma rising with the corona is indeed the primary source of thermal plasma observed in the corona during flares. (2) Resolved: The excess line broading of UV and X-ray lines is accounted for by a convective velocity distribution in evaporation. It is concluded that the hypothesis that convective evaporation produces the observed X-ray line widths in flares is no more than a hypothesis. It is not supported by any self-consistent physical theory. (3) Resolved: Most chromospheric heating is driven by electron beams. Although it is possible to cast doubt on many lines of evidence for electron beams in the chromosphere, a balanced view that debaters on both sides of the question might agree to is that electron beams probably heat the low corona and upper chromosphere, but their direct impact on evaporating the chromosphere is energetically unimportant when compared to conduction. This represents a major departure from the thick-target flare models that were popular before the Workshop. Author

N87-19335*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FLARE ENERGETICS
S. T. Wu (Alabama Univ., Huntsville), C. deJager (Utrecht State Univ., Netherlands), B. R. Dennis, H. S. Hudson (California Univ., San Diego), G. M. Simnett (Birmingham Univ., England), K. T. Strong (Lockheed Missiles and Space Co., Palo Alto, Calif.), R. D. Bentley (Mullard Space Science Lab., Dorking, England), P. L. Bornmann (Joint Inst. for Lab. Astrophysics, Boulder, Colo.), M. E. Bruner (National Center for Atmospheric Research, Boulder, Colo.), and P. J. Cargill (Armagh Observatory, Northern Ireland) *In its* Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 20 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

In this investigation of flare energetics, researchers sought to establish a comprehensive and self-consistent picture of the sources and transport of energy within a flare. To achieve this goal, they chose five flares in 1980 that were well observed with instruments on the Solar Maximum Mission, and with other space-borne and ground-based instruments. The events were chosen to represent various types of flares. Details of the observations available for them and the corresponding physical parameters derived from these data are presented. The flares were studied from two perspectives, the impulsive and gradual phases, and then the results were compared to obtain the overall picture of the energics of these flares. The role that modeling can play in estimating the total energy of a flare when the observationally determined parameters are used as the input to a numerical model is discussed. Finally, a critique of the current understanding of flare energetics and the methods used to determine various energetics terms is outlined, and possible future directions of research in this area are suggested. Author

N87-19336*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ENERGETICS OF THE GRADUAL PHASE
K. T. Strong, R. D. Bentley (Mullard Space Science Lab., Dorking, England), P. L. Bornmann (Joint Inst. for Lab. Astrophysics, Boulder, Colo.), M. E. Bruner (Lockheed Missiles and Space Co., Palo Alto, Calif.), P. J. Cargill (Maryland Univ., College Park), J. G. Doyle (Armagh Observatory, Northern Ireland), J. R. Lemen (Mullard Space Science Lab., Dorking, England), R. Pallavicini (Osservatorio Astrofisico di Arcetri, Florence, Italy), G. Peres (Osservatorio Astronomico, Palermo, Italy), S. Serio et al *In its* Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 20 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

Reseachers compare results with those in the chapter by Moore et al. (1980), who reached five main conclusions about the gradual phase: (1) the typical density of the soft X-ray emitting plasma is between 10 to the 11th power and 10 to the 12th power cm-3 for compact flares and between 10 to the 10th power and 10 to the 11th power cm-3 for a large-area flare; (2) cooling is by conduction and radiation in roughly equal proportions; (3) continual heating is needed in the decay phase of two-ribbon flares; (4) continual heating is probably not needed in compact events; (5) most of the soft-X-ray-emitting plasma results from chromospheric evaporation. The goal was to reexamine these problems with the data from the Solar Maximum Mission (SMM) and other supporting instruments as well as to take advantage of recent theoretical advances. SMM is capable of measuring coronal temperatures more accurately and with a better cadence than has been possible before. The SMM data set is also unique in that the complete

transit of an active region was observed, with soft X-ray and UV images being taken every few minutes. Researcher's were therefore able to establish the pre-flare conditions of the region and see whether anything has changed as a result of the flare. The assumptions made in attempting to determine the required plasma parameters are described. The derived parameters for the five prime flares are presented, and the role of numerical simulations is discussed. Author

N87-19337*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATIONSHIPS AMONG THE PHASES
C. J. Crannell and H. S. Hudson (California Univ., San Diego) *In its* Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 3 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

The overall flare process involves phenomena characterized as the impulsive and gradual phases, following the X-ray signature first recognized by Kane (1969). In addition, evidence exists for a pre-flare phase in some flares, and recent Solar Maximum Mission data have shown that a post-flare phase, in which extensive and energetically important coronal activity occurs, may also exist. The data to describe the pre-flare and post-flare phases are insufficient to place them properly into an overall picture of the energetics, aside from noting that these phases may indeed be significant from the energetics point of view. What is presently known is reviewed and comments are made about the possible interactions among the flare structures involved. Author

N87-19338*# California Univ., San Diego.
CHARACTERIZATION OF TOTAL FLARE ENERGY
H. S. Hudson *In* NASA. Goddard Space Flight Center Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 7 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

It is concluded that the estimates of total energy in the prime flares lie well below the Active Cavity Radiometer Irradiance Monitor upper limits. This is consistent with our knowledge of the energy distribution in solar flares. Insufficient data exist for us to be very firm about this conclusion, however, and major energetic components could exist undetected, especially in the EUV-XUV and optical bands. In addition, the radiant energy cannot quantitatively be compared at this time with non-radiant terms because of even larger uncertainties in the latter. Author

N87-19339*# Utrecht State Univ. (Netherlands).
A REVIEW OF IMPULSIVE PHASE PHENOMENA
C. deJager *In* NASA. Goddard Space Flight Center Energetic Phenomena on the Sun. The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 14 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

A brief review is given of impulsive phase phenomena in support of the models used to compute the energies of the different components of the flares under study. The observational characteristics of the impulsive phase are discussed as well as the evidence for multi-thermal or non-thermal phenomena. The significance of time delays between hard X-rays and microwaves is discussed in terms of electron beams and Alfven waves, two-step acceleration, and secondary bursts at large distances from the primary source. Observations indicating the occurrence of chromospheric evaporation, coronal explosions, and thermal conduction fronts are reviewed briefly, followed by the gamma ray and neutron results. Finally, a preferred flare scenario and energy source are presented involving the interactions in a complex of magnetic loops with the consequent reconnection and electron acceleration. Author

N87-19340*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CORONAL MASS EJECTIONS AND CORONAL STRUCTURES
E. Hildner (National Center for Atmospheric Research, Boulder, Colo.), J. Bassi (Colorado Univ., Boulder), J. L. Bougeret, R. A. Duncan (Commonwealth Scientific and Industrial Research Organization, Sydney, Australia), D. E.Gary (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.), T. E. Gergely, R. A. Harrison (National Center for Atmospheric Research, Boulder, Colo.), R. A. Howard (Hale Observatories, Pasadena, Calif.), R. M. E. Illing (National Center for Atmospheric Research, Boulder, Colo.), B. V. Jackson (California Univ., San Diego) et al *In its* Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 71 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

Research on coronal mass ejections (CMF) took a variety of forms, both observational and theoretical. On the observational side there were: case studies of individual events, in which it was attempted to provide the most complete descriptions possible, using correlative observations in diverse wavelengths; statistical studies of the properties CMEs and their associated activity; observations which may tell us about the initiation of mass ejections; interplanetary observations of associated shocks and energetic particles even observations of CMEs traversing interplanetary space; and the beautiful synoptic charts which show to what degree mass ejections affect the background corona and how rapidly (if at all) the corona recovers its pre-disturbance form. These efforts are described in capsule form with an emphasis on presenting pictures, graphs, and tables so that the reader can form a personal appreciation of the work and its results. Author

N87-19341*# Los Alamos National Lab., N. Mex.
INTERCOMPARISON OF NUMERICAL MODELS OF FLARING CORONAL LOOPS
R. A. Kopp, G. H. Fisher (Lawrence Livermore National Lab., Calif.), P. MacNeice (Science Research Council, Chilton, England), R. W. P. McWhirter, and G. Peres (Osservatorio Astronomico, Palermo, Italy) *In* NASA. Goddard Space Flight Center Energetic Phenomena on the Sun: The Solar Maximum Mission Flare Workshop. Proceedings Dec. 1986 9 p (For primary document see N87-19328 11-92)
Avail: NTIS HC A18/MF A01 CSCL 03B

The proposed Benchmark Problem consists of an infinitesimal magnetic flux tube containing a low-beta plasma. The field strength is assumed to be so large that the plasma can move only along the flux tube, whose shape remains invariant with time (i.e., the fluid motion is essentially one-dimensional). The flux tube cross section is taken to be constant over its entire length. In planar view the flux tube has a semi-circular shape, symmetric about its midpoint s = s sub max and intersecting the chromosphere-corona interface (CCI) perpendicularly at each foot point. The arc length from the loop apex to the CCI is 10,000 km. The flux tube extends an additional 2000 km below the CCI to include the chromosphere, which initially has a uniform temperature of 8000 K. The temperature at the top of the loop was fixed initially at 2 X 1 million K. The plasma is assumed to be a perfect gas (gamma = 5/3), consisting of pure hydrogen which is considered to be fully ionized at all temperatures. For simplicity, moreover, the electron and ion temperatures are taken to be everywhere equal at all times (corresponding to an artificially enhanced electron-ion collisional coupling). While there was more-or-less unanimous agreement as to certain global properties of the system behavior (peak temperature reached, thermal-wave time scales, etc.), no two groups could claim satisfactory accord when a more detailed comparison of solutions was attempted. Author

N87-19342*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE PICK-UP OF COMETARY PROTONS BY THE SOLAR WIND
M. Neugebauer, A. J. Lazarus (Massachusetts Inst. of Tech., Cambridge), K. Altwegg (Bern Univ., Switzerland), H. Balsiger, B. E. Goldstein, R. Goldstein, F. M. Neubauer (Cologne Univ., West Germany), H. Rosenbauer (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, West Germany), R. Schwenn, and E. G. Shelley (Lockheed Missiles and Space Co., Palo Alto, Calif.) Mar. 1987

13 p
(Contract NGL-22-009-015)
(NASA-CR-180212; NAS 1.26:180212) Avail: NTIS HC A02/MF A01 CSCL 03B

The High Energy Range Spectrometer (HERS) of the Ion Mass Spectrometer on the Giotto spacecraft measured the 3-dimensional distribution of picked-up cometary protons over a distance of approximately 8 million km upstream of the bow shock of Comet Halley. The protons were observed to be elastically scattered out of their original cycloidal trajectories such that they were nonuniformly distributed over a spherical shell in velocity space. The shell radius (relative to its expected radius) and thickness increased as the bow shock was approached. Downstream of the shock, the cometary protons could not be distinguished from the heated solar wind protons. Author

N87-19343# Los Alamos National Lab., N. Mex.
A REVIEW OF MATTER OSCILLATIONS AND SOLAR NEUTRINOS
S. P. Rosen 1986 6 p Presented at the Summer Study on the Physics of the Superconducting Super Collider, Snowmass, Colo., 23 Jun. 1986
(Contract W-7405-eng-36)
(DE87-002899; LA-UR-86-3980; CONF-8606215-19) Avail: NTIS HC A02/MF A01

The theory of the Mikheyev-Smirnov-Wolfenstein effect is reviewed, and its consequences for the solar neutrino problem are examined. Using a two-flavor model, the solutions in the Delta m sup2 -sin sq 2 Theta parameter space for the Cl-37 experiment are discussed, and their predictions for the Ga-71 experiment and for the spectrum of electron-neutrinos arriving at earth described. DOE

N87-19198# Science Research Council, Chilton (England). Space and Astrophysics Div.
A COMPARISON OF FAR-UV SPECTRA OF SOLAR AND STELLAR FLARES
K. J. H. Phillips and G. E. Bromage *In* ESA Proceedings of an International Symposium on New Insights in Astrophysics. Eight Years of UV Astronomy with IUE Sep. 1986 p 209-212 (For primary document see N87-19150 11-88)
Avail: NTIS HC A99/MF E03

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N87-19344* Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
ON THE THEORY OF TYPE 1 X-RAY BURSTS: THE ENERGETICS OF BURSTS AND THE NUCLEAR FUEL RESERVOIR IN THE ENVELOPE
Masayuki Y. Fujimoto (Niigata Univ., Japan), Mirek Sztajno, Walter H. G. Lewin (Massachusetts Inst. of Tech., Cambridge), and Jan vanParadijs (Amsterdam Univ., Netherlands) Aug. 1986 41 p Submitted for publication Sponsored in part by an Alexander von Humboldt Stiftung, the John Simon Guggenheim Memorial Foundation and the Max-Planck-Gesellschaft
(Grant NAG8-571)
(NASA-CR-180230; NAS 1.26:180230; MPE-Preprint-66; ETN-87-99323) Copyright. Avail: Issuing Activity CSCL 03B

The observed properties of type 1 X-ray bursts from 4U/MXB 1636-53 and those of models of thermonuclear flashes on accreting neutron stars are compared. Ways to explain variations in the burst recurrence properties without an apparent correlation with the accretion rate, including the rapid succession of bursts at intervals < 10 min are discussed. The strongest X-ray bursts, which occur after a very long interval, are well described by thermonuclear flash models with simple accumulation of accreted fuel, and a spherically symmetric structure in the burning shell. The majority of observed bursts, however, occur after much shorter intervals, and radiate much smaller amounts of energy, by a factor of up to 10 times that predicted by the spherical models. An ignition mechanism of the bursts is proposed in terms of elemental mixing and dissipative heating associated with hydrodynamical instabilities in the neutron star envelope caused by angular momentum carried inward by accreted gas. ESA

N87-19345 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
EXOSAT OBSERVATIONS OF X-RAYS FROM CLASSICAL NOVAE DURING OUTBURST STAGE
Hakki Oegelman, Joachim Krautter (Landessternwarte auf dem Koenigstuhl, Heidelberg, West Germany), and Klaus Beuermann Aug. 1986 26 p Submitted for publication
(MPE-Preprint-68; ETN-87-99325) Copyright. Avail: Issuing Activity

Three EXOSAT observations of Nova Muscae 1983, 3 observations of Nova Vulpeculae 1984-1 (PW Vul), and observations of Nova Vulpeculae 1984-2 were analyzed. The soft X-ray light curve of classical novae was sampled from optical maximum to 900 days after. The observations seem best explained by the constant bolometric luminosity model of a hot white dwarf remnant. Although the measurements suffer from limited statistics, very broad energy bandpass, and incomplete sampling of any single nova, their constraints on the theories of nova outburst are significant. ESA

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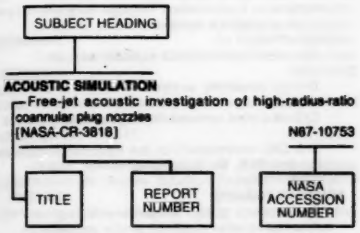

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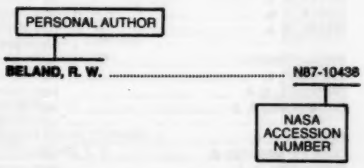

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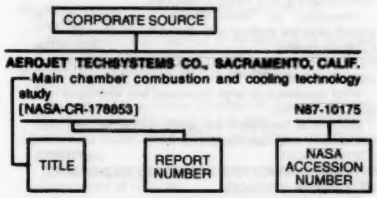

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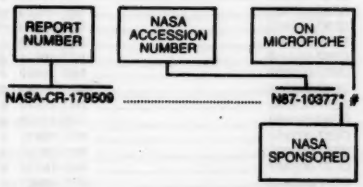

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NLR-MP-86002-U ..... N87-19017 #
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NLR-MP-86009-U ..... N87-18662 #
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NLR-MP-86021-U ..... N87-18589 #

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MAINE

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Tri-State Regional Documents Depository
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(207) 581-1680

MARYLAND

UNIVERSITY OF MARYLAND
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MASSACHUSETTS

BOSTON PUBLIC LIBRARY
Government Docs. Dept.
Boston, MA 02117
(617) 536-5400 ext.226

MICHIGAN

DETROIT PUBLIC LIBRARY
Sociology Department
5201 Woodard Avenue
Detroit, MI 48202
(313) 833-1409

MICHIGAN STATE LIBRARY
P.O. Box 30007
Lansing, MI 48909
(517) 373-0640

MINNESOTA

UNIVERSITY OF MINNESOTA
Government Pubs. Division
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7813

MISSISSIPPI

UNIV. OF MISSISSIPPI LIB.
Documents Department
University, MS 38677
(601) 232-5857

MONTANA

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA

NEBRASKA LIBRARY COMM.
Federal Documents
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Lincoln, NE 68508
(402) 471-2045
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NEVADA

UNIVERSITY OF NEVADA LIB.
Govt. Pub. Department
Reno, NV 89557
(702) 784-6579

NEW JERSEY

NEWARK PUBLIC LIBRARY
5 Washington Street
Newark, NJ 07101
(201) 733-7812

NEW MEXICO

UNIVERSITY OF NEW MEXICO
Zimmerman Library
Government Pub. Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY
Reference Department
325 Don Gaspar Avenue
Santa Fe, NM 87501
(505) 827-2033, ext. 22

NEW YORK

NEW YORK STATE LIBRARY
Empire State Plaza
Albany, NY 12230
(518) 474-5563

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Wilson Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1321

NORTH DAKOTA

UNIVERSITY OF NORTH DAKOTA
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-2617, ext. 27
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OHIO

STATE LIBRARY OF OHIO
Documents Department
65 South Front Street
Columbus, OH 43215
(614) 462-7051

OKLAHOMA

OKLAHOMA DEPT. OF LIB.
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-6546

OREGON

PORTLAND STATE UNIV. LIB.
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

PENNSYLVANIA

STATE LIBRARY OF PENN.
Government Pub. Section
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Harrisburg, PA 17105
(717) 787-3752

TEXAS

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927—Cap. Sta.
Austin, TX 78753
(512) 471-2996

TEXAS TECH. UNIV. LIBRARY
Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH

UTAH STATE UNIVERSITY
Merrill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

VIRGINIA

UNIVERSITY OF VIRGINIA
Alderman Lib.—Public Doc.
Charlottesville, VA 22901
(804) 924-3133

WASHINGTON

WASHINGTON STATE LIBRARY
Documents Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA

WEST VIRGINIA UNIV. LIB.
Documents Department
Morgantown, WV 26506
(304) 293-3640

WISCONSIN

MILWAUKEE PUBLIC LIBRARY
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3000

ST. HIST LIB. OF WISCONSIN
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

WYOMING

WYOMING STATE LIBRARY
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